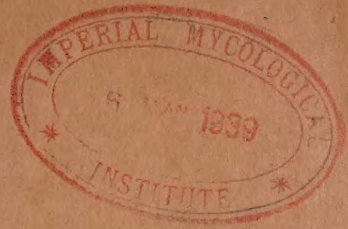


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REPORT OF THE AGRICULTURAL SURVEY OF THE FIVE MOST NORTHERLY DISTRICTS OF NYASALAND.

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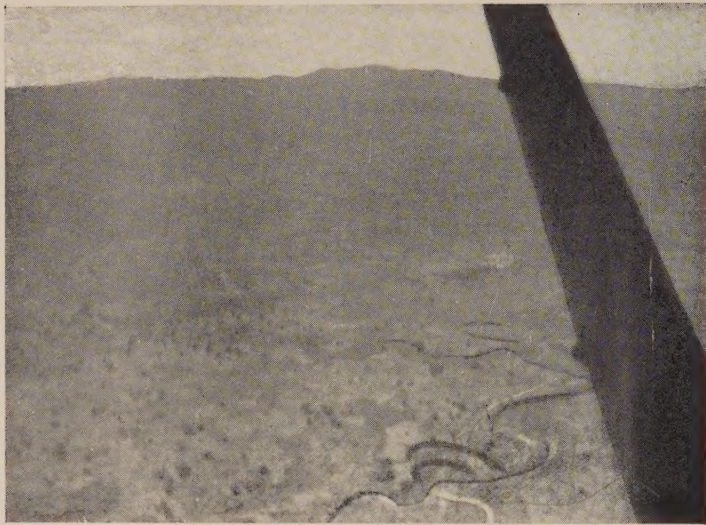
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1

Kasitu valley near Jakwa from the air indicating general poor nature of country and scarcity of trees.



2

Poor Bractystegia open woodland and inferior grass on hard red lateritic soils covering much country over 4,000 feet elevation near Ekwendeni.



3

Tree veld with *Acacia camphyacantha* several *Combretum* spp., *Bridelia* sp., *Terminalia sericea*. Partially cleared with high growth of *Panicum maximum*, *Hyparrhenia rufa*. Good Likuni red loam, in Southern Kasungu.

REPORT OF THE AGRICULTURAL SURVEY OF THE FIVE MOST NORTHERLY DISTRICTS OF NYASALAND.

INTRODUCTION.

The committee appointed by His Excellency the Governor to enquire into emigrant labour in 1935 drew attention to the lack of a complete agricultural and economic survey of the five northern districts (page 43 of the report). These are Kota Kota, Kasungu, Mzimba, West and North Nyasa. As a result of the recommendation of the committee it was decided to investigate as completely as possible in these five districts the distribution of various types of soil, the variation in the climate and vegetation of the chief agricultural divisions, the production and methods of cultivation of food-crops and the possibilities of extending further the production of economic crops. This survey during 1937 and 1938 was in general charge of the Assistant Director of Agriculture and Chemist who already had at his disposal data on climate and soils of several important areas, and also reports by several other officers during the past twelve years on vegetation and crops of northern Nyasaland. Data and reports obtained in past years have therefore been edited and embodied as parts of this report under the names of the officers concerned.

These past reports include the results of a detailed survey of the Misuku country west of Karonga, and of the Upper Ahenga hill areas by Mr. F. Barker when Agricultural Officer of North Nyasa, reports of a survey of the Vipya highlands and West Nyasa by Mr. E. W. Davy when Assistant Director of Agriculture and a survey of much of Northern Nyasa by Mr. A. J. W. Hornby when Agricultural Chemist.

During the past twelve years the latter has accumulated meteorological records from which the climate of most of northern Nyasaland can be described with a fair degree of accuracy.

Mr. A. C. Williamson surveyed parts of Kota Kota and Kasungu in 1934 and in 1937 surveys of large areas were completed by Messrs Pryor, Smalley, and Fenner.

The Entomologist and the Cotton Specialist, Empire Cotton Growing Corporation, made special reports on coffee and cotton prospects in the Ahenga country of North Nyasa.

Assistance during 1937 was also given by the Agricultural Officers of North Nyasa and Kota-Kota who rendered valuable reports and prepared soil maps of the areas covered during the course of their duties.

Reports of tours in the Nyika and Vipya highlands by the Acting Chief Veterinary Officer, Capt. Culhane, some years ago have also been generously placed at the disposal of the survey.

Thanks are due to these gentlemen for the large amount of information on all agricultural matters which has been forwarded to headquarters. It has been possible to publish many of the reports on more important areas in full.

MAPS.

All officers concerned in the survey forwarded maps with a large amount of information on the distribution of soils, vegetation and population. A large skeleton map has been in process of reproduction for some months and upon this map will eventually be superimposed the more significant data of rainfall, soils and population density. Elevation of the various zones will be shewn.

FINANCE.

The work of the survey was financed largely by a grant from the Colonial Development Fund.

FORM OF THE REPORT.

The report is divided into parts of which the first describes as far as is at present known the climate of northern Nyasaland. Upon the basis of climate and elevation the whole area is portioned into agricultural divisions and the parts of the report succeeding the first part give the descriptions of each division with in many cases full reports which have been written by the officers concerned.

The final parts of the report will deal with aspects of various food and economic crops, notes on livestock and grazing and special appendices on soil and vegetation data.

AGRICULTURAL SURVEY. PART 1.

THE CLIMATE OF THE FIVE MOST NORTHERLY DISTRICTS OF NYASALAND

BY

A. J. W. HORNBY, M.B.E., B.SC., A.I.C., Assistant Director of Agriculture and Chemist.

INTRODUCTION.

An agricultural survey under the general supervision of the writer was carried out during 1937 and 1938. This covered the greater part of the districts of Kasungu, Kota-Kota, Mzimba, West Nyasa and North Nyasa and it is intended in the following pages to describe as far as it is possible from existing meteorological and other records the climate of the districts in question. In the first place it is desired to place on record the great help given in the collection of information and records by District Commissioners, by planters and missionaries, particularly workers in the Overtoun Institute, Livingstonia.

Much of what has been written (1) (2) * concerning the monsoon and warm temperate oceanic climates of south central Africa must apply to the climate of the long, generally narrow strip of land which borders on the west side of Lake Nyasa and which contains the large mountain masses of the Nyika, the long and high Vipya watershed and other highland areas.

2. THE CLIMATE IN GENERAL.

The characteristics of a monsoon climate with a pronouncedly wet summer and early autumn, followed by a winter and spring of varying dryness, are well exemplified in nearly all areas of northern Nyasaland. Winds following on the constant southerly breezes of early spring commence to blow strongly in September and the first small rains are met with in these areas sometimes in late October but more generally in November. Heavy rainfalls however do not usually occur in most areas till December although some highlands and mist-belts are exceptions.

The first rains are accompanied by much thunder and are more localised than those of late January and February. Furthermore as can be seen from the table of rainfall records (page 14) very heavy rains often occur in March following the general steady rains of January and February. The intensity of the rains lasts much longer in North and West Nyasa than in all other areas, April and May often being very wet months in West Nyasa. Rains effective as far as plant growth is concerned are frequent in certain of these areas in June, July and August but generally September and October are the driest of the year.

The prevailing winds in these areas are from the south and south-east. The windward side of the mountain areas are naturally the wettest and there are numerous "rain-shadow" areas on the lee-sides. The most noteworthy of these are the South Rukuru Valley north-east of Jakwa, eastern Mzimba generally and the Ngara-Vua littoral. The effect of the rain-shadow is more noticeable at the beginning of the rains and in the autumn and winter periods.

In North Nyasa itself together with the considerable variation in elevation due to the large mountain masses, there is also an added complication of northerly winds which blow from the southern Tanganyika highlands for some considerable periods and which extend sometimes through the northern Vipya highlands. These winds often bring added precipitation in the middle of the rainy season to certain hill areas but again there may be steep hill sides which dry up quickly during a prolonged dry season and which burn fiercely quite early.

It will be noted that the climate of nearly the whole of Mzimba, Kota-Kota, Kasungu, and the lowlands of North Nyasa is definitely of the monsoon type, that of large areas nearby having also less than seven inches during the six monthly period June to November, much of which is ineffective as far as plant growth is concerned. Such a monsoon climate is very different to that found in the short monsoon areas of the greater part of India for example and indeed in the higher areas with lower temperatures and a high humidity continually being supplemented from the large body of water nearby, the climate might be described as warm temperate oceanic. Such a climate is found in China, New South Wales, and Natal, where certain crops are successful and should also do well in these high areas. (2).

* Reference by number is to Literature cited, page 11.

The climate in such a comparison can be found to be superior to others of similar nature in Brazil and Northern Australia where large and long narrow areas suffer from considerable extremes of seasonal rainfall and temperature. In such areas the annual rainfall has varied from 95 per cent above to 65 per cent below the mean. Certainly in the wetter areas of West Nyasa the March rainfall exhibits such a variation from year to year and the annual rainfall varies from 94 to 45 inches but such figures are exceptional for northern Nyasaland and there is no such failure of rains which are experienced in Brazil and lead to widespread famines.

The greatest variation occurs in the rain-shadow areas already referred to. Rainfall varies considerably from one season to another but these areas are generally narrow and serious food shortage due entirely to weather conditions is rare.

Temperatures also do not exhibit a very wide diurnal or seasonal range, the average daily range generally being 18°F, that of January being 20° and of October and November 25°. The absolute maximum on the Lake Shore has been 100.3° at Chinteché and 98° at Karonga.

Such a phenomenon as hail is often met with in hill areas during the early part of the rains. Whirlwinds of varying intensity known as *cifumbulu* and *nalipembezu* also occur during the spring and early summer.

Naturally the weather conditions to be expected during the growing season determines to the greatest extent the choice of food and economic crops by the agriculturist and the methods and time of planting employed in their cultivation. As one proceeds northwards the growing season generally commences much later than in central areas and indeed near Karonga itself crops are generally planted a month later than in the Southern Province. The growing season also in these northerly areas is of much greater duration than similar ones at the same elevation further south.

8. CLIMATIC ZONES.

Reference may here be made to the admirable physical map of the Director of the Geological Survey to emphasize the existence of climatic zones which differ fundamentally from one another. Elevations vary from 1,550 feet to over 8,000 feet above sea level with numerous steep escarpments and steep-sided valleys. Temperatures and humidities at any one time vary greatly over a few miles, especially in the dry six months of the year. The average rainfall during the six wet months also varies greatly, a total of 100 inches occurring in some years in parts of West Nyasa which has a general average of 65. In the drier parts of Mzimba and Kasungu, the general average is below 30 inches and in these more westerly areas there is not the great variation from one year to another found in the eastern zones.

The area can be most usefully divided up primarily on a climatic basis and the area under review can be divided into twelve definite agricultural divisions of any importance, elevation and distribution of soil groups and vegetation being also taken into account. The numbers given follow on those given to the agricultural divisions of Central Nyasaland. (1.)

- XIII. The Kota Kota and eastern Dowa highlands.
- XVII. The southern Kasungu area and main Kasungu plain.
- XVIII. The highlands of southern Mzimba and northern Kasungu.
- XIX. The Akamanga and South Rukuru plains.
- XX. The Nyika and Misuku mountain and hill areas.
- XXI. The Vipya highlands and downs.
- XXII. The Ahenga hills and vales.
- XXIII. The cotton belt of southern Kota Kota.
- XXIV. The lowlands of northern Kota Kota.
- XXV. The eastern Vipya, Limpasa, Konga areas.
- XXVI. The Vua-Ngara littoral.
- XXVII. The Karonga-Songwe plain.

A brief description of each of these divisions can here be given.

XIII. THE KOTA KOTA AND EASTERN DOWA HIGHLANDS

This zone forms a watershed running approximately north and south between the Lake littoral and the large plains to the west, with elevations from 2,500 in the east and 3,300 in the west rising to 5,000 feet in the main peaks of Chipata, Nchisi, Kongwe and Chiponde which are

surrounded by much broken country with many steep slopes. Quite fertile soils are found in valleys and on gentle slopes particularly near Mlanga and Mpongozi. The average annual rainfall varies from 35 to over 40 inches, being considerably more than that of the plains to the west. The climate generally is pleasant and healthy and there is a considerable native population on the good soils found in the valleys and on minor plateaux. The only economic crop is tobacco which is sold on the buying station of the Native Tobacco Board at Mponela. Tobacco indeed grows very well at high elevations during the normal rainy season which is an added criterion of the superior climate in these highlands compared with that found at similar elevations in more southerly areas.

The zone can be said to end in the north in the poor hill country north and south of the Bua at an elevation above 2,500 feet where a game reserve is proposed. This includes the hills of Vundinira and the poor Chipululu sandy and stony country at lower elevation. This is really a continuation of the so-called Nsanga country carrying open woodland and poor orchard country which runs at an elevation of over 2,000 feet throughout the lowlands of southern Kota Kota.

XVII. THE SOUTHERN KASUNGU AREA AND MAIN KASUNGU PLAIN.

This zone south of the Chimaliro forest reserve and below an elevation of 4,000 feet consists of a flat plain stretching southwards to the Bua river and is traversed by the Dwangwa and minor streams which generally flow in slight depressions known as dambos. The zone can be said to end in the east at 3,900 ft. elevation when the rivers fall rapidly to the lake plains. The zone contains the large Fort Alston forest and game reserve into which no further settlement or development is allowed.

This zone is the driest in northern Nyasaland with a rainfall below 30 inches over the greater part, nearly 95 per cent of which falls in four months. Such a precipitation naturally limits the number of food and economic crops which can be grown. Furthermore the range of temperatures are similar to those at Lilongwe so that only short term crops such as certain types of tobacco are successful. This subject will be gone into in full in a later part of the survey report.

XVIII. THE HIGHLANDS OF SOUTHERN MZIMBA AND NORTHERN KASUNGU.

This minor zone contains many small hills and broken country generally above an elevation of 4,000 feet, the highest peak being Perekezi at 6,000. It is bounded on the east by the southern Vipya highlands and downs and with this area forms a watershed of the South Rukuru. It includes the forest reserves of Perekezi and Chimaliro. The upper reaches of the South Rukuru and tributaries are generally of superior fertility and the rainfall similar to that of Mzimba is invariably sufficient for most annual crops. The climate of these hill areas is superior to that of the Kasungu plain to the south and at high elevations mists and high humidities are common. Here the country is well wooded, mosses being common and much good grassland is found.

XIX. THE AKAMANGA AND SOUTH RUKURU PLAINS.

These plains lie at an altitude from 3,500 to 5,000 feet and experience an annual rainfall up to 40 inches which is of the dry monsoon type, 95 per cent falling in a five monthly period. Strong southerly winds blow continuously over these areas from July to October as over the Kasungu and Lilongwe plains and the country rapidly dries up. Bush fires are common and equally destructive to those in the latter areas.

Temperatures in winter are exceptionally low, injurious frosts being quite common throughout this area. The dryness and early coldness of this zone limits the number of annual crops and it is unfortunate that the native agriculturist should have shown such a predilection for the short term finger millet which is grown by a method so destructive of woodland growth.

This zone may be extended to include the Hewe-Viwaze marsh area.

XX. THE NYIKA AND MISUKU MOUNTAIN AND HILL AREAS.

XXI. THE VIPYA HIGHLANDS AND DOWNS. (SEE ALSO 3.)

Practically no meteorological observations have been made in these extensive areas so that native information and local observation must be relied upon for our knowledge of climate. It is thought reasonable in this brief sketch to consider these two zones together from various points of view. The average elevation of the former is somewhat higher but the temperatures, humidities and rainfall over large areas differ very little for the greater part of the year. The

latter lies parallel and closer to Lake Nyasa and much of it is more fully exposed to the moisture-laden winds from the south and east but the rain-shadow effect comes into play in both zones.

The normal annual rainfall is over 55 inches in the six wet months and over 5 inches in the winter and spring periods.

There are numerous "mist belts" in these mountain areas where in winter and spring there is high humidity and frequent heavy dews. The climate generally is healthy and invigorating to Europeans but is unpopular for native settlement. There are great areas of rolling downland with frequent steep slopes covered with grassland with good potential pasturage. This is usually referred to as the Vipya and Nyika country proper.

In areas sheltered from the drying winds of winter deciduous scrub and open woodland appear, together with upper montane rain forest near Usamwala and the northern Misuku country. The escarpments to the north and east of the main massifs together with the Kandoli mountain experience a high rainfall similar that of the highlands round Luwazi and Vizara and are covered with *Brachystegia* open woodland and high grass-low tree savannah, the latter on better soils.

The highest mountain peak rises to a height of over 8,000 feet dominating the southern Nyika plateau with an average elevation of about 7,000. This forms the important watershed of part of the North Rukuru, the northern tributaries of the South Rukuru and the annual rainfall here must often be over 80 inches. The highest peak in the Vipya is over 6,000 feet and here again the annual rainfall must often reach over 70 inches.

Besides the steeply sloping areas, there are also several large dambos or gently sloping depressions which may form the head waters of rivers such as the Ruvuo, Lufira and Songwe. Generally the climate and soil lead to good growth of nutritious grasses alongside such dambos.

In the Nyika proper, the grass flora on the high hills and downs is similar to those of the Vipya and Misuku with the exception of *Setaria grandis* which seems to have an undeservedly bad reputation as feed for stock.

The northern Nyika plateau averages about 5,500 feet and is generally more broken and hilly than the southern plateau. The Misuku country east of Fort Hill is very similar.

The small hollows in all these areas, unless surrounded by very steep slopes falling sheer to the water courses as in the Rumpi valleys or Jakwa gorges, contain deep friable loams with good humic layers.

Cattle of certain breeds when acclimatized should with care and protection from wild beasts do quite well in these highlands. The value of the grassland steppe has been described by other observers (3.) and is generally superior by the dominance of such grasses as *Themeda triandra*, *Tristachya inanoema*, *Heteropogon cymbaria*, *Cleistachne sorghoides*, etc., to much of the High Veld of southern Africa, which these zones so closely resemble. On the poorer soils and rocky hills numerous species of sedges are found.

XXII. THE AHENGA HILLS AND VALES.

Below the high scarps and steep hill slopes of the Nyika mountains are a series of small hills and undulating vales generally covered with inferior tree and grass vegetation. Such country north and east of the Jakwa is often referred to as the Upper and Lower Ahenga country. Climatically they can be considered as one zone with an average rainfall of over 40 inches, nearly ninety per cent falling in the six wet months December to May. The elevation of the zone may be taken as from 3,000 to 4,500 feet and the minor areas at this elevation of Livingstonia and of the eastern scarp west of Vua may be regarded as climatically similar.

The zone is traversed by certain streams and rivers which become torrents in the wet season. The climate and topography generally has given rise to the typical foothill *Brachystegia* woodland and savannah and there has been considerable native cultivation which has done damage to the soils and vegetation. Indeed in the Kasitu and South Rukuru valleys below Jakwa which may also be taken as part of this climatic zone trees are comparatively scarce up to an elevation of 3,700 ft. and soil erosion has been extensive. Much of these Ahenga hill areas lie in the rain shadow of the mountains of Usamwala and the Vipya so that in those areas on the eastern side of the vales rainfall is often comparatively low and uncertain.

The Upper Henga valley from the Livingstonia Mission at Kondowe to the experimental plots at Nchena Chena contain many more fertile valleys and useful red loams on hillsides than do the areas as far as Zombwe farm.

XXIII. THE COTTON BELT OF SOUTHERN KOTA KOTA.

Little need be said concerning this zone at low elevations below 2,500 feet. Though the rainfall is generally much higher than that encountered during the average growing season in the better cotton areas of Dowa and parts of the Southern Province, the higher temperatures are a more favourable factor in growth and the long dry season covers a large period of the growth of the crop and helps to keep in check many crop pests.

Kota Kota town itself has an average annual rainfall of over 50 inches, about ninety-five per cent of which falls in the six wet months November to April and a larger precipitation usually falls to the north of the town. The limit of the cotton belt can be traced by the 40 inch isohyet, areas to the south of this containing much fertile alluvium with broad strips of poor *Brachystegia* country on the higher land which have already been referred to.

XXIV. THE LOWLANDS OF NORTHERN KOTA KOTA.

The higher rainfall in the lowlands north of Kota Kota has been noted and the area contains much surface water, open pools and small lakes occurring frequently in the narrow Lake littoral where again the higher level of the past few years has inundated quite large stretches of fertile land. The zone is quite narrow and the broken *Combretum* and *Brachystegia* country is soon met with as one proceeds westwards along the valleys of the Lipachi, Dwangwa and Bua and indeed the hill of Kirwirwi drops sheer to the lake shore, before the small extension of lake littoral north and south of Bandawe is continued to the north. Very broken country with numerous ravines cover many miles to the north-west of this zone until the Vipya grasslands are encountered.

XXV. EASTERN VIPYA, LIMPASA, KONGA AREAS. (SEE ALSO 4')

The relation of this zone to the Vipya highlands and downs can be compared to that of the Ahenga country to the Nyika mountain area. Being on the eastern side of the Vipya highlands, however, and directly in the path of the rain bearing winds, it experiences an exceptionally high and prolonged rainfall which varies between 70" and 90" and, in places sometimes reaches well over the 100" mark. At Vizara on the eastern edge of this zone an average of 15" for the month of April is recorded while September to November are usually dry. This, however, is no criterion of the major portion of the zone which lies much nearer to the Vipya escarpment and is subject to the influence of the Kandoli highlands and scarps. It may therefore reasonably be supposed to possess a far more uniform distribution.

The altitude being from 2,000 to 3,500 feet both temperatures and humidity are generally high. While cool nights may be experienced during the winter months, temperatures in the valleys making up so much of this zone are much higher than those of similar elevations in neighbouring zones. Comparison may usefully be made with the tea belts of southern Nyasaland where climatic conditions of great similarity to those in this zone occur.

It is unfortunate that large areas of fertile land do not occur and it is hard to find continuous areas of five hundred acres with good soil and vegetation. The name Vizara itself really means an isolated area of good fertility.

NOTE:—It is interesting to observe the native names of the rains usually met with in West Nyasa in July, October and November. These are respectively *Kuku lanyuni*, *sungwa lamatori* and *Chisimwi malupya*. The literal meanings are the rains which sweep up the grass seeds, those which put out the smouldering fires in gardens, and those which put out large grass fires.

XXVI. THE VUA-NGARA LITTORAL.

The wide strip of plain which comprises this zone lies at an altitude of from 1,550 to 2,200 feet. The climate is considerably drier than that of the Karonga-Songwe plain, the average annual rainfall being below 35 inches over the greater part of the fertile areas. June to November are exceptionally dry months for North Nyasa and towards the end of this period temperatures during the day are fairly high although 96°F is rarely exceeded. Nights remain cool, however, throughout the dry season with fairly high humidities. The area is protected from the south and west by mountain ranges which at Florence Bay slope steeply almost to the Lake Shore. It may not be quite correct to include the minor areas of the well-wooded Vintukuta-Deep Bay and Hara littoral as part of this zone because the rainfall and humidity are somewhat higher in the normal year, but the areas are small and development should be on very similar lines to that taking place near Ngara.

The difference in climate and soil is reflected in the difference in vegetation, that at Vua being largely the typical *Acacia albida* woodland on fertile Lake Shore alluvium soil while the woodland at Vintukuta is of the *Brachystegia-Burkea africana* type.



4

Open woodland of *Uapaca kirkiana* with *Erica arborea* *Hyparrhenia cymbaria* and numerous sedges on sour soils of the lower Vipya country over 4,000 feet elevation.



5

Low elevation thorn country—dry forest found on banks of rivers flowing into Lake Nyasa.



6

Lake shore vegetation on good alluvium. Palm stands with *Sterculia* and *Adansonia* in background on higher ground.

XXVII. THE KARONGA-SONGWE PLAIN.

This zone is an extension of that previously described. It possesses a very much higher rainfall which increases from some 50 inches in the south to over 60 inches in the north. Of this some three inches fall during the six dry months from June to November. Towards the end of the dry season the incidence of rainfall is very erratic and in November itself there may be no rain with unpleasantly high temperatures and humidity or as much as seven inches may fall in sudden storms. In the months from December to May very heavy falls may be encountered, rarely a season passing without over twenty inches falling in a period of thirty days, such a period being generally in March. The period during which most crops make the best growth is quite different to that of more southerly areas. For example cotton and tobacco give the best results in most seasons if planted at least a month later than the optimum time of planting in central areas.

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TABLES OF TEMPERATURES AT NORTHERN STATIONS (*see also 1*).

KASUNGU.

TEMPERATURES.

						Mean Daily Extremes.		
			Mean Max.	Mean Min.		Max.	Min.	
January	...	...	89.4	60.7	...	97	...	56
February	...	...	87.6	60.3	...	95	...	57
March	...	...	87.7	59.3	...	94	...	54
April	...	...	87.5	54.9	...	94	...	49
May	...	...	84.4	52.8	...	91.4	...	40.2
June	...	...	82.9	44.8	...	91.4	...	37
July	...	...	82.9	44.4	...	88.4	...	40
August	...	...	83.4	45.2	...	91.4	...	42.0
September	...	...	87.4	51.5	...	95	...	44.6
October	...	...	91.1	58.1	...	98	...	51
November	...	...	93.8	62.2	...	100.4	...	57.8
December	...	...	91.1	61.7	...	100.6	...	60.8

KOTA-KOTA.

TEMPERATURES.

						Mean Daily Extremes.		
			Mean Max.	Mean Min.		Max.	Min.	
January	...	...	88.9	69.5	...	99	...	65.2
February	...	...	87.9	68.7	...	94.9	...	62.8
March	...	...	86.3	67.9	...	95.1	...	62.5
April	...	...	84.9	68.2	...	95.5	...	62.3
May	...	...	85.1	68.0	...	92.3	...	60.4
June	...	...	83.6	67.9	...	89.5	...	59.6
July	...	...	83.8	66.9	...	90.0	...	60.1
August	...	...	84.6	64.8	...	90.3	...	60
September	...	...	89.8	64.2	...	97.3	...	62.8
October	...	...	92.4	71.7	...	100	...	65.8
November	...	...	93.4	72.6	...	101.2	...	70
December	...	...	88.3	66.5	...	99	...	72

KARONGA.

TEMPERATURES.

						Mean Daily Extremes		
			Mean Max.	Mean Max.		Max.	Min.	
January	...	...	89.2	69.2	...	95	...	66.7
February	...	...	89.1	70.4	...	95	...	67.4
March	...	...	89.5	69.8	...	93.8	...	65
April	...	...	85.1	69.2	...	90.3	...	65
May	...	...	86.1	68.8	...	90.5	...	64.5
June	...	...	85.8	62.6	...	89.2	...	58.2
July	...	...	83.1	62.6	...	86.1	...	56
August	...	...	85.9	61.1	...	90.1	...	56.8
September	...	...	88.2	64.5	...	92.8	...	62.5
October	...	...	89.9	69.6	...	98.3	...	67
November	...	...	92.1	72.1	...	99	...	69.6
December	...	...	90.5	72.2	...	96	...	70

CHINTECHI.

TEMPERATURES.

			Mean Max.		Mean Min.		Mean Daily Extremes.		
							Max.		Min.
January	...	...	89.3	...	69.6	...	99.5	...	72.4
February	...	...	87.5	...	69.1	...	95.1	...	73.6
March	...	...	86.3	...	68.7	...	93.5	...	72.5
April	...	...	84.7	...	68.4	...	95.3	...	67.4
May	...	...	83.8	...	68.6	...	93	...	61
June	...	...	79.7	...	66.3	...	89.1	...	58.2
July	...	...	78.6	...	63.8	...	88.0	...	58.4
August	...	...	81.6	...	64.2	...	86.8	...	59.2
September	...	...	83.2	...	66	...	93.3	...	59.4
October	...	...	92.5	...	68.7	...	99.1	...	68
November	...	...	92.3	...	72.7	...	99	...	66.7
December	...	...	86.1	...	68.8	...	95	...	72

MZIMBA.

TEMPERATURES.

			Mean Max.		Mean Min.		Mean Daily Extremes.		
							Max.		Min.
January	...	...	78.4	...	59.9	...	79.4	...	54
February	...	...	76.7	...	59.7	...	80.5	...	54
March	...	...	75.7	...	59.8	...	79	...	52
April	...	...	75.6	...	58.2	...	79	...	49
May	...	...	75.0	...	54.5	...	78	...	48
June	...	...	74.3	...	52.3	...	69.8	...	48.7
July	...	...	73.6	...	47.0	...	77	...	40.5
August	...	...	74.8	...	50.4	...	78	...	48
September	...	...	78.5	...	54.9	...	83	...	45
October	...	...	81.1	...	60.2	...	86	...	51
November	...	...	82.1	...	61.2	...	86	...	51
December	...	...	80.4	...	60.3	...	85	...	55

NKWALI EXPERIMENTAL STATION.

Weather conditions here are generally similar to those prevailing in south-eastern Kota Kota which may be said to have a similar climate to Nkwali.

TEMPERATURES.

			Mean		Mean daily extremes			Relative	
			Maximum	Minimum	Max		Min	Humidity	
January	...	...	83.8	68.3	90.1	...	64.1	...	76.0
February	...	...	83.0	67.5	88.0	...	65.4	...	76.7
March	...	...	83.1	66.5	86.5	...	61.0	...	77.9
April	...	...	82.6	63.4	86.5	...	56.7	...	74.9
May	...	...	81.6	57.6	85.6	...	51.0	...	66.3
June	...	...	77.8	53.1	83.0	...	46.0	...	62.3
July	...	...	77.7	52.5	83.7	...	46.7	...	61.3
August	...	...	80.2	54.8	83.0	...	47.9	...	71.9
September	...	...	85.6	60.1	91.1	...	51.7	...	60.5
October	...	...	90.9	65.5	95.7	...	58.8	...	60.8
November	...	...	91.4	70.7	97.4	...	63.5	...	61.4
December	...	...	86.0	70.0	93.7	...	64.3	...	69.7

AVERAGE RAINFALL FOR EACH MONTH AT RECORDING STATIONS.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	ALTITUDE feet
*Nkwali (7 years)	9.45	8.22	4.72	1.79	.09	.01	.01	—	—	.05	1.76	5.80	81.90	2000
Kota Kota Boma (20 years) ...	10.52	10.49	15.03	4.30	.85	.32	.13	.13	.09	.14	2.02	8.47	52.49	1600
Kasungu Boma (12 years)	9.00	6.81	5.56	1.23	.04	.01	—	.03	—	.18	1.81	7.02	91.69	3500
Mzimba Boma (14 years)	8.04	6.92	6.47	1.55	.09	.07	.02	—	.06	.10	1.46	5.94	90.72	4300
Chinteché Boma (24 years)	8.31	9.45	15.00	16.53	4.88	2.07	1.30	.38	.15	.62	3.10	7.75	69.34	1600
Vizara (10 years)	10.11	9.26	15.96	17.00	7.84	2.77	2.51	1.84	—	—	—	10.73	77.52	2300
Nchenachena (2 years)	8.91	9.03	9.53	8.53	2.63	.74	.26	.20	—	.30	2.38	10.56	53.02	8800
Livingstonia (20 years)	9.30	9.88	12.04	11.90	2.56	1.86	.72	.27	.21	.24	2.02	7.11	58.11	4400
Vua (13 years)	5.75	6.09	8.42	4.04	.47	.09	.11	.01	.07	.16	.38	6.18	31.72	1580
Nyungwe (8 years)	6.29	6.59	7.38	3.08	.67	.03	.03	—	—	.05	1.48	6.25	31.85	2000
Deep Bay (8 years)	7.80	7.90	13.13	11.53	3.17	.75	.24	.06	—	.18	.04	6.09	50.89	2400
Karonga Boma (14 years)	8.52	7.38	12.46	7.09	1.64	.26	.09	.07	.03	.07	1.33	6.59	45.53	1580

* Experimental Station of the Department of Agriculture and the Empire Cotton Growing Corporation.

A table is appended showing food and economic crops which should grow well in the various zones. To decide whether any of the latter crops would be of real value in economic progress and become definitely cash crops in a permanent agriculture is fully to be gone into at a later stage by means of an economic survey.

CROPS WHICH SHOULD GROW WELL IN THE ZONES.

XIII	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII
Lima beans ...	—	Lima beans ...	Lima beans	Many introduced species of grasses	—	Coffee ... (Arabica & robusta)	Cotton Sim Sim	—	Coffee at higher elevations ...	Cotton Sim Sim	Cotton Sim Sim
Haricot and other Phaseolus ...	—	Haricot beans	—	—	—	Olives ...	—	—	Tea, Cincona, Citrus(Lime) *	—	—
Chick pea	—	—	—	—	—	—	—	—	—	—	—
Tung Oil †	Tung Oil ...	Tung oil ...	Tung Oil	Teff grass in valleys	—	—	Castor oil	Castor Oil	Tung Oil Para rubber ...	—	—
Various type of tobacco	Various type of tobacco ... (Bright, Turkish, etc.) ...	Tobacco ...	—	Edible canna ...	—	Bananas	Bananas ...	Bananas ...	Bananas	Castor Oil Some type of tobacco Bananas ...	Bananas
Wheat and Oats ...	—	Wheat and Oats	—	Eddoes, Tania	—	Wheat ... Oats ... Haricot beans ...	—	—	Many fruit trees ...	Pearl millet	Pearl millet
Bananas	—	—	—	—	—	—	—	—	Oil palm	Date palm	—
Sunflower	—	—	—	Yams	—	—	—	Rice ...	Rice ...	Rice ...	Rice †
Jute (Corchorus. sp).	Rice ...	Olives ...	—	—	—	—	Sugar cane	—	Sugar cane	—	Sugar cane
Hemp	Jute (Corchorus. sp)	—	—	—	—	Pigeon pea	Pigeon pea	Pigeon pea	Pigeon pea	Pigeon pea	Pigeon pea
China grass	—	Many fruit trees, Zeeland flax.	New Zealand flax.	—	—	—	Kapok ...	Kapok ...	Jute	Kapok ...	Kapok
Papaya and many fruits.	—	Flax ...	—	Carob bean in valleys.	—	New Zealand flax	Sisal ...	Sisal ...	Sisal	Sisal	Sisal
Vetiver	—	Carob bean ...	—	—	—	—	—	—	Manila fibre. New Zealand flax.	Sunflower Strophanthus flax.	Jute New Zealand flax.
Citronella and lemon grass	—	—	—	—	—	—	—	—	—	—	Coco-nut.

NOTE. With the exception of part of the climatic zones with an elevation above 3 500 feet the following are not to be grown well in nearly all parts of Southern, Western, and Central Africa. In the latter parts, except in the mountainous regions, finger millet, proso and barnyard millet, many sorghums, Bambara groundnuts, buckwheat, and soya beans, field peas, velvet beans, and sunhemp.

Fodder crops in great number can be grown in all the above zones.

* See also (5) page 7. Lime for oil extraction.

† See also (6)

† See also (6)

NYASALAND

TEA GROWING AREAS OF NYASALAND

SHOWING ISOHYETS OF RAINFALL FOR SIX WET MONTHS AND SIX DRY MONTHS

SCALE 1:500,000

LEGEND

TRUE TEA AREAS
BOTH SPECIES OF TEA OIL
[UNUSUALLY FOR TOBACCO]

BORDER LINE AREAS FOR TEA AND TOBACCO
MONTANA TEA OIL, CORREA AREAS ON BUTABA BEL

SHIRE VALLEY

SHIRE RIVER

SAVE RIVER

MLANJE MASSIF

PORTUGUESE EAST AFRICA

ZOA FALLS

ISOHYETS

42 INCH ISOHYET
SIX WET MONTHS

40

7

5

SIX DRY MONTHS

RIVERS

ROADS

RAILWAY

Average rainfall in the tea belts of Mlanje and Solo for comparison with that of West Nyasa.

Average rainfall in the tea belts of Mlanje and Cholo for comparison with that of West Nyasa.

DIAGRAM OF AGRICULTURAL DIVISION OF NYASALAND

AVERAGE ANNUAL RAINFALL IN INCHES	ELEVATION 1500-2000	ELEVATION 2000-3000	ELEVATION 3000-4000	ELEVATION OVER 4000
20-30	BWANJE VALLEY FORT JOHNSTON SALIMA	MACLEAR PENINSULA <i>Hyphaene crinata</i> FORESTS (TSANYA) <i>Ficokelia</i> TREES PALM STANDS	KASUNGU FORT ALSTON RESERVE <i>Acampylacantha</i> AND <i>Anigrescens</i> ORCHARD COUNTRY	
30-35	DOMIRA BAY LIWONDE MPIMBE VUA	KAWINGA NAMALANGA PIRILONGWE BALAKA LIKANGALA TUCHILA CHIKALA HILLS	LILONGWE-DOWA LIVILEZI ACAIIA THORN VELD WOODLAND	DIAMPWE WESTERN LINTIPE
35-40	LIRANGWE SUMBUR	<i>Mopane</i> THORN TREES (<i>Acacia</i>) HIGH GRASS-LOW TREE SAVANNAH	<i>Brachystegia</i> WOODLAND NCHU FORT MANNING WOODLAND	DZALANYAMA MZIMBA MPHUNZI-DEDZA-MLUNDUNI
40-50	LUVUNZU <i>Copaifera</i> <i>Tamarind</i>	LUCHENZA KONJENI WOODLAND	<i>Brachystegia</i> WOODLAND <i>Uapaca</i> WOODLAND (MASUKU) MAHOAGANY VALLEY AHENGA TREES BLANTYRE WOODLAND	DEDZA EKWENOENI HIGHLANDS VIPYA MOUNTAIN GRASSLAND
50-60	KOTA KOTA OPEN KARONGA	GLENORCHY <i>Brachystegia</i> WOODLAND	ZOMBA WOODLAND CHOLO BOMA WOODS	ZOMBA WOODLAND PLATEAU GRASSLAND
60-90	CHINTECHE NKATA BAY TROPICAL MONSOON TYPE RAIN	SAYAMA MLANJE LUTERI <i>Uapaca</i> (3) TROPICAL MONSOON TYPE FOREST	CHOLO MOUNTAIN	LIVINGSTONIA YELLOW-WOOD AND CEDAR FORESTS MLANJE PLATEAU

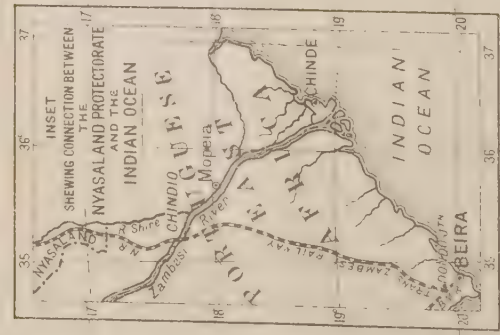


AGRICULTURAL SURVEY
OF NYASALAND
RAINFALL MAP
SUMMER AND AUTUMN CLIMATE
NOVEMBER 1ST TO APRIL 30TH
COMPILED BY
A. J. W. HORNBY

Scale: 2000000 or 1 inch to 31.56 Miles
0 5 10 20 30 40 50 MILES
0 5 10 20 30 40 50 60 70 KILOMETRES

(These islands are included in the KOTA KOTA DISTRICT for purposes of administration)

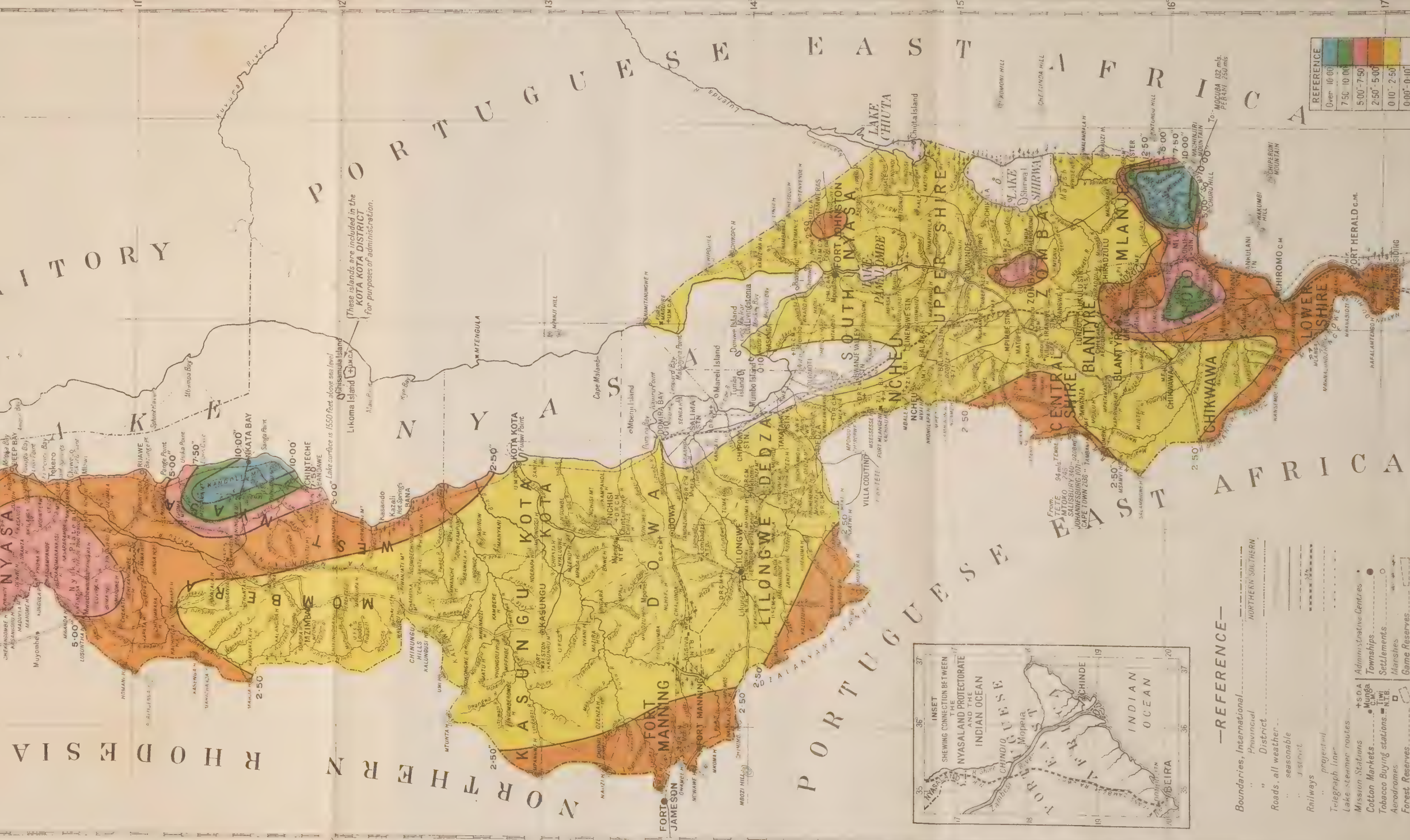
REFERENCE	
Over 70"	
60" - 70"	
50" - 60"	
40" - 50"	
35" - 40"	
30" - 35"	
Under 30"	



- REFERENCE—
- Boundaries, International
 - " Provincial
 - " District
 - Roads, all weather
 - " seasonal
 - " district
 - Railways
 - Telegraph lines
 - Lake steamer routes
 - Mission Stations
 - Cotton Markets
 - Tobacco Buying stations
 - Aerodromes
 - Forest Reserves
 - Administrative Centres
 - Townships
 - Settlements
 - Marshes
 - Game Reserves

AGRICULTURAL SURVEY
OF NYASALAND
RAINFALL MAP
WINTER AND SPRING CLIMATE
MAY 1ST TO OCTOBER 31ST
COMPILED BY
A.J.W. HORNBY

Scale: 2,000,000 or 1 inch to 31.56 Miles
0 10 20 30 40 50 60 70 80 KILOMETRES
0 5 10 20 30 40 50 MILES



REFERENCE

0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000
0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000



—REFERENCE—

- Boundaries, International
- Provincial
- District
- Roads, all weather
- seasonable
- Railways
- Telegraph line
- Lake steamer routes
- Mission Stations
- Cotton Markets
- Tobacco Buying stations
- Aerodromes
- Forest Reserves
- Administrative Centres
- Towns
- Settlements
- Marshes



7

Wind damage and erosion may be severe. Bractystegia woodland with trees blown down by a gale.



8

Native cultivation on badly eroded soil with poor grassland. The bare rocky masses found over large areas may be noted. These lead to extensive run-off.



9

Poor orchard country and deciduous scrub typical of that found on the lower slopes of Mzimba hill country.

AGRICULTURAL SURVEY. PART 2.

THE KOTA KOTA HIGHLANDS.

Report by Mr. J. W. PRYOR who as a supervisor of the Native Tobacco Board has made extensive tours in these highlands.

HILL AREAS UNDER NATIVE AUTHORITY KANYENDA.

The only areas containing much fertile soil in these highlands covers about two square miles near the villages of Mzanje and Tomchipeta.

The highlands are generally very broken and thinly populated, only 600 able bodied men being present who are mainly Achewa. The proposal that the greater part of this area should be made a game reserve has been referred to.

It is an impossible country for economic crops although a surplus of a small tonnage of groundnuts might be obtained in some years.

Elevations : 2,500 to 5,000 ft.

AREAS UNDER NATIVE AUTHORITY KALUMU INCLUDING MALENGA AND OTHER ACHEWA VILLAGES.

On the fertile areas between Mpelele and the Dowa—Kota Kota road is produced the dark-fired tobacco sold at Mponela. The distribution of soils of all these areas will be shown on the Soil Map in course of preparation.

North of the tobacco producing areas is much broken country as far as Mpasa Hill which is generally of poor fertility and mostly uninhabited.

East of Mpasa Hill areas of good fertility are met with but water supplies are scanty, some native villages depending on sources five miles away towards the end of the dry season.

Between Mpasa Hill and main road are some fertile valleys with medium soil elsewhere. A large percentage of the gardens are on poor soil and steep slopes where red sandy soils are common.

East of the main road the country falls away quickly and contains very broken poor land with scanty population.

The area north of the Kasungu—Kota Kota road as far as the Bua river is also very broken with frequent steep slopes.

Elevations : 3,500 to 4,200 ft.

AREAS UNDER NATIVE AUTHORITY KALUMU INCLUDING NTONDO WHERE NATIVES ARE BOTH ANGONI AND ACHEWA.

This area lies between the Kota Kota—Dowa road and the Nchisi mountains. It contains many small hills with well watered valleys, the soil being grey medium loams with sandy soils in the northern parts.

This country is exceptionally fertile and shortage of food is very rare anywhere. Dimba gardens which can be planted in winter are plentiful. Good tobacco has been produced but overproduction of dark tobacco generally led to poor prices which discouraged growers after the long transport to Mponela. There are 860 able-bodied natives in this area of 37,760 acres so that it is unfortunate that long and expensive transport to the railway or lake precludes the production of anything but high priced commodities.

Elevations : 3,000 to 5,000 ft.

Mr. F. F. Smithyman, Senior Supervisor of the Native Tobacco Board, who also knows the Kota Kota highlands well, has assisted with the preparation of the soil map and makes the following notes :

People. The people are of the Achewa and Angoni tribes and are more of a hunting than agricultural type. They spend every available moment in well organized game hunts in which whole villages meet and join in a hunt which lasts for days and incidently destroys whole areas of timber and grass lands for their hunting is done by firing the bush.

Cattle. Game abounds in the area north and north-west of Nchisi and on the eastern and southern slopes of the mountain. This area is very badly infested with tsetse-fly and consequently there are no cattle. To offset this shortage of domestic animal life, villages keep large numbers of goats, pigs and sheep. In the more heavily populated areas of the south western highlands cattle have been established but with no marked success. It is very obvious that until the tsetse-fly problem is overcome cattle could not be introduced with any hope of success.

Village locality. Heavy concentration of villages is only noticed in two places: in the area between the Dowa-Lilongwe road and the Kasuma and Bondo hills in the north-east and the area between on the south east of Nchisi Mountain and the Mpelele River in the north west. Other than in these areas villages are scattered in groups of 4 or 5 where the people have found patches of well watered and fertile soil. It is understood that in the areas in question there are only some 1500 able-bodied men.

Soils. Soils vary from the rich loam of the valleys, the medium loam and sandy loam of the upland flats, the medium sandy soils of the stretch running down to the Bua river and infertile gravelly soils of the hill slopes. With regard to the first types these are highly fertile and are productive.

As there is a limited area and acreage of land in the valleys no extension could take place. The medium loams of the upland flats are the largest tract of fertile land in the highlands which might be worthy of development and improvement in agricultural methods. Dark fired tobacco was successfully introduced into this area and some good quality leaf has and is still being produced. The introduction of ground nuts as a secondary cash crop might meet with fair success.

In the area consisting of grey sandy soils the production of foodstuffs is not very satisfactory and consequently there are few villages and these are only to be found where there is good water and patches of medium good soils. Here again ground nuts might be worth a trial.

The generally infertile areas are cultivated in patches by a number of people who burn large quantities of timber on their gardens for millets, pumpkins, etc.

In conclusion it is considered that there is no area large enough to be worthy of extensive agricultural development.

AGRICULTURAL SURVEY. PART 3.

THE SOUTHERN KASUNGU AREA AND MAIN KASUNGU PLAIN.

These areas have been surveyed by Mr. A. C. WILLIAMSON, C.D.A., in 1934 and by Mr. J. E. L. FENNER in 1937. A summary of their reports is given here and the distribution of soils will be given on the Soil Map in course of preparation.

SECTIONS. N. A. Santhe, N. A. Mwase, N. A. Chulu and N. A. Kaluluma.

AREA.	N. A. Mwase and N. A. Chulu	...	...	1,600 Sq. miles
	N. A. Santhe	...	...	390 "
	N. A. Kaluluma	...	...	550 "
			Total	2,540 Sq. miles

Note: These figures exclude the Fort Alston game reserve—1,200 Sq. miles—and the Chimaliro Forest reserve—50 Sq. miles.

NO. OF VILLAGES.	N. A. Mwase and N. A. Chulu	...	...	...	240
	N. A. Santhe	...	...	...	20
	N. A. Kaluluma	...	...	...	83
			Total		343

POPULATION.	N. A. Mwase and N. A. Chulu	...	...	...	17,500
	N. A. Santhe	...	...	...	1,200
	N. A. Kaluluma	...	...	...	9,000
			Total (a)		27,700

TRIBES. Mostly Achewa. Few Chipeta in the south and a few Tumbuka and Angoni in the north.

ELEVATION AND NATURAL FEATURES.

(a) South of the Dwangwa river consists of undulating plain, between 2,500 and 3,500 ft. traversed by numerous wide dambos.

A few scattered hills are to be found in the south and south east.

In the north east the country becomes more broken and rocky outcrops are common.

(b) North of the Dwangwa river the country rises steadily to the Chimaliro hills at about 4,000 ft. being more broken in the East and the North. Several prominent hills occur over the area. These although not high, are conspicuous owing to the flatness of the surrounding country. Dambos, although plentiful, are composed of poor sand, while the water table is generally lower than in the South.

MAPS.

Forest reserve boundaries, as usual, presented some difficulty, more especially as there was no sketch map obtainable and the natives in villages adjacent to the reserve were very vague on the subject.

The tsetse belt. The fly-free area is limited to a radius of about five miles round Kasungu mountain and the area north of the Milenje stream.

SOILS.

Much of the area is very patchy. Strips of moderate and good sandy loams occur between stretches of poorer sands, and vice versa; while small strips of good, light textured, grey alluvium are found on many of the dambo fringes.

In the soil maps the small strips have been disregarded and the predominant soil types inserted.

Many of the strips in question cover no more than a few hundred square yards and would therefore be impossible to insert on such small scale maps.

The occurrence of the different soil types can be seen on the maps, therefore a brief summary is all that is necessary here.

(a) *Excessively sandy soils of poor fertility.*

These are by far the most common types in the district and occur in broad stretches over large areas.

In the south the principal areas are found :—

1. Along the Bua river in N. A. Santhe's section.
2. Along the north bank of the Rusa river.
3. In a broad band running from east to west.

North of the Dwangwa river poor sands cover most of the area to within a few miles of the Hill ranges in the extreme north. This stretch contains some of the most infertile country in the district.

(b) *Light sandy loams.*

These may be divided into three types :—

1. Light sandy loams over light subsoils.
2. Light, red sandy loams over medium textured subsoils.
3. Light sandy loams over heavy subsoils with a high clay content.

1. These are by far the most common, appear to be moderately fertile. Any abnormal variation in the rainfall has disastrous effects on the productive powers, and villages situated on them are always open to food shortage.

They occur principally in the western, central, and southern portions of the district, the main road being their approximate easterly limit.

2. These are confined to the extreme north of the district, occurring in the vicinity of the hill ranges. They appear to be of good fertility although they do not always give good maize crops, and seem more suited to groundnuts, beans and potatoes. They extend into Mzimba where the area covered by them is much greater than that in the Kasungu district.

3. This type is found in the east and would seem to give the most consistent crops.

It appears especially suited to maize production and all villages situated on it have large stocks of maize.

Beans appear to do indifferently and it is not as suitable for groundnut cultivation as either of the former.

(c) *Medium Loams.*

These occur in small patches all over the district, the principal being in the east round the Tembe stream, and in the south west between the Sitchi and Chiputa dambo. Other smaller areas are to be found :—

Down the boundary of the Fort Alston game reserve.

East of the Chitete stream.

Round the rocky outcrops in the east.

Adjacent to and west of Manyani hill in the south.

South of the Kalingwana hills in the extreme north west.

(d) *Light textured grey alluvium.*

Soils are to be found along the margins of many of the dambos, more especially those of the Dwangwa and Bua rivers.

In most cases their size is negligible and nowhere do they cover a large area.

They are extremely fertile, easily worked, and practically all are utilized for food crops.

Small as many of these strips are, the not infrequent occurrence in poor sandy areas makes them invaluable to the community.

(e) *Heavier Soils.*

Only three heavy soil patches were noted of the following types :—

Heavy black alluvium occurring in the south round Chomola village.

Heavy red loam found east of Manyani hill.

Heavy brown loam between the Bua and Rusa rivers east of N. A. Santhe's own village.

None of these areas are large and, although the second area is cultivated intensively, the other areas carry only a few gardens, due, presumably, to the extra energy required in tillage operations.

(f) *Dambos*.

The area covered by dambos in this district is considerable. Two types are to be found.

1. Heavy black (Makandi) soils.
2. Exceedingly sandy types.

The former are most common south of the Dwangwa river, while the latter occur in the north and are, of course, quite useless for agricultural purposes.

The fringes of the black dambos, which often merge into the light grey alluvium, are cultivated fairly extensively.

VEGETATION HAS HERE BEEN DIVIDED ACCORDING TO THE TYPES OF SOIL IT WAS NOTED ON.

There is some little difference between the vegetative types found on similar soils in different parts, which would appear to be caused by slight variations in altitude and, possibly, depth of water table. For instance, on the better light sandy loams in the south, *Terminalia sericea* vern. Napini grows freely, while, in the north, its place appears to be taken by *Pterocarpus angloensis* vern. Mlombwa.

As however all trees enumerated occur to a greater or lesser extent on the soil types described below and the vegetation lists attached to soil samples indicate the local variations, the generalisation is in the main correct.

Further subdivision of vegetation into northern and southern zones would merely lead to a repetition of names. The distance and difference between the two extremes was considered insufficient to warrant it.

The following divisions have therefore been made:

1. Poor sandy types.
2. Light loams and medium textured brown loams.
3. Heavier loams and heavy black alluvium.
4. Friable, grey sandy alluvium and dambo fringes.

1. Poor sandy types.

Predominant:

<i>Brachystegia</i> sp.	(Mombo)
<i>Isobertia globiflora</i>	(Kamponi)
<i>Isobertia paniculata</i>	(Ntondo)

Other Varieties:

<i>Brachystegia appendiculata</i>	(Mapa)
<i>Diplorrhynchus angustifolia</i>	(Mtomoni)
<i>Pseudolachnostylos maprouneifolia</i>	(Msolo) Stunted
<i>Uapaca kirkiana</i>	(Msuku)
<i>Uapaca nitida</i>	(Kasokolowe)
<i>Parinari</i> sp.	(Muula)
<i>Antidesma venosum</i>	(Mupululu) small

2. Light loams and medium textured brown loams.

Predominant:

<i>Parinari</i> sp.	(Muula) large
<i>Terminalia sericea</i>	(Napini)
<i>Pterocarpus angolensis</i>	(Mlombwa)

Other varieties:

<i>Brachystegia</i> sp.	(Mombo)
<i>Brachystegia appendiculata</i>	(Mpapa)
<i>Isobertia globiflora</i>	(Kamponi)
<i>Isobertia paniculata</i>	(Ntondo)
<i>Pseudolachnostylos maprouneifolia</i>	(Nsolo) large
<i>Crossopteryx febrifuga</i>	(Dangwe)
<i>Combretum</i> sp.	(Kalama)
<i>Burkea africana</i>	(Mkalati)
<i>Euphorbia</i> sp.	(Ngachi)
<i>Uapaca kirkiana</i>	(Msuku)—few
<i>Uapaca nitida</i>	(Kasokolowe)—local
<i>Afromosia angolensis</i>	(Mwanga)—few
<i>Bauhinia thonningii</i>	(Chitimbe)
<i>Kigelia</i> sp.	(Mvunguti)—local
<i>Zizyphus</i> sp.	(Kankande)—local
<i>Acacia</i> sp.	(Mtete)—local
<i>Faurea</i> sp.	(Chiere) local (North)
<i>Cassia</i> sp.	(Ntandanyerere)
<i>Cassia didymobotrya</i>	(Njerenjere)
<i>Dalbergia</i> sp.	(Kulasinga)
<i>Dichrostachys nyassana</i>	(Mpangala)
<i>Oxyanthus speciosus</i>	(Mpwapwa) local (North)
<i>Landolphia florida</i>	(Nchefu)—local

3. Friable grey sandy alluvium and dambo fringes.

Predominant:

<i>Syzygium</i> sp.	(Nyowe) dambo fringes
<i>Zizyphus</i> sp.	(Kankande) dambo fringes
<i>Ficus</i> sp.	(Nkuyu) Both
<i>Acacia</i> sp.	(Mtete) Both
<i>Dichrostachys nyassana</i>	(Mpangala) grey soils
<i>Bauhinia petersiana</i>	(Muua) grey soils

Other Varieties: (Practically all associated with grey alluvium only)

<i>Bauhinia thonningii</i>	(Chitimbe)
<i>Pterocarpus angolensis</i>	(Mlombwa)
<i>Diplorrhynchus angustifolia</i>	(ntomoni)—large
<i>Pseudolachnostylos maprouneifolia</i>	(Nsolo)—few
<i>Ficus</i> sp.	(Kachere)
<i>Ficus ingens</i>	(Mtawa)
<i>Kigelia</i> sp.	(Mvungutu,
<i>Terminalia sericea</i>	(Napini)
<i>Antidesma venosum</i>	(Mpululu)
<i>Burkea africana</i>	(Mkalati)
<i>Strychnos spinosa</i>	(Muyai)
<i>Lonchocarpus capassa</i>	(Chimbakasa)
<i>Markhamia obtusifolia</i>	(Msewa)
<i>Gardenia</i> sp.	(Mtseche)
<i>Albizzia lebbek</i>	(Mpepe)
<i>Albissia</i> sp.	(Mtangatanga)

4. Heavier loams and heavy black alluvium:

Predominant:

<i>Acacia</i> sp.	(Mtete)
<i>Combretum mechowianum</i>	(Nalitengere) Heavy loams
<i>Acacia woodii</i>	(Msidzi) Black alluvium

Other varieties:

<i>Zizyphus</i> sp.	(Kankande)
<i>Strychnos spinosa</i>	(Muyai)
<i>Bauhinia Thonningii</i>	(Chitimbe)
<i>Ficus</i> sp.	(Nkuyu)
<i>Lonchocarpus capassa</i>	(Chimbakasa)
<i>Markhamia abtusifolia</i>	(Msewa)
<i>Dichrostachys nyassana</i>	(Mpangala)
<i>Afrormosia angolensis</i>	(Mwanga)
<i>Seleracarya caffra</i>	(Mfula)
<i>Combretum</i> sp.	(Kalama)
<i>Combretum</i> sp.	(Mkuti)
<i>Erythroxylum</i> sp.	(Kafupa)
<i>Stereospermum kunthianum</i>	(Nlakanjobvu)
<i>Vitex cuneata</i>	(Msimpisia)
<i>Diplorrhynchus</i> sp.	(Tombodzi)

WATER SUPPLY.

Practically all streams and rivers shown on existing maps are dambos pure and simple, with no actual bed of any description.

In the black makandi dambos south of the Dwangwa river the water table is, in most cases, well within reach of ordinary native water holes. Towards the east, however, the dambos are very much smaller and water is harder to obtain.

North of the Dwangwa the poor sand dambos are much drier, but in the extreme north round the hills and along the Mzimba boundary in the north east water is fairly plentiful.

The only perennial stream in the district is the Lodjwa, a tributary of the Lusituzi.

Some of the larger rivers dry up into pools; sometimes hundreds of yards long; which give as good a water supply as a dam. These are six in number Bua, Rusa, Dwangwa, Kalindi, Lungadzi, and Kabwari.

Inhabited areas where wells are urgently needed may be briefly listed here:

N. A. Santhe's Section:	i. N. A. Santhe's village	1 well
	ii. Chيامa village	1 „
	iii. Adamponde village	1 „
	iv. Kolowale „	1 „

N. A. Mwase's Section :	i. Diwala village	1 well
	ii. Njobvu " }	
	Chinemba " }	2 "
	Mphepo " }	
	Chinyama " }	
	iii. Chimbaye " }	
	Nkondo " }	1 "
	Mamkalala " }	
	iv. Mtika "	1 "
	v. Mduwa "	1 "
N. A. Chulu's Section :	i. N. A. Chulu's village }	1 "
	Mphazi " }	
	ii. Mphoka " }	1 "
	Vizume " }	
	iii. Malanda " }	1 "
	Kasiche " }	
	iv. Chilowa "	1 "
	v. Khombe "	1 "

The inhabited portion of N. A. Kaluluma Section possesses an adequate water supply.

DISTRIBUTION OF VILLAGES.

N. A. Mwase and N. A. Chulu. The main concentration of villages in these sections lies along the boundary of the Fort Alston game reserve.

There is a further concentration round N. A. Mwase's village near the Kasungu Boma, and another on the good medium loam near the Kota Kota boundary in the East.

The three groups account for most of the 240 villages in the sections.

A large proportion of the remainder lie scattered along the Rusa and Bua rivers in the South.

Isolated groups of three and four villages also to be found on the better soil patches over the sections, but these are very far apart.

There is a long strip of uninhabited country running down the Fort Alston game reserve boundary. The soil in this area is mainly brown loam of good fertility and numerous dambos simplify the water supply question. However, in view of the damage done to crops by game, the settlement of this area is not advisable at present. Villages that were in it and adjacent to the boundary have now moved away and a "safety line" for cultivation has formed automatically. Even this suffers from sporadic invasions sometimes causing grave food shortages. That the villages on this line and north of the Dwangwa are practically on the reserve boundary is explained by the fact that most of the game tends to concentrate in the better grassed makandi dambos in the south.

Most of the other uninhabited areas in this section consist of poorer sandy types which although not absolutely infertile cannot be recommended for settlement.

Exceptions occur along the Rusa and Bua rivers; between Chilindira and Ntumbo villages—where water would be needed and in places along the south bank of the Dwangwa river.

N. A. Santhe's Section. The few villages in this section are distributed over the whole area.

Large parts of the section are suitable for settlement although in most cases wells would have to be constructed.

N. A. Kaluluma's Section. The majority of the villages are grouped north and south of the Chimaliro Forest reserve in the extreme North and there is also a small concentration round N. A. Kaluluma's own village.

The remainder are scattered over the poor sandy soils that cover most of the area wherever water can be obtained.

There is so little good soil in this section that further settlement does not seem feasible, in fact, those villages now situated on the poor sands are constantly moving in an endeavour to find better gardens.

CROPS.

Maize does well on all the medium and light loams. It is fairly satisfactory on some of the better sands but very subject to seasonal variations, slight excess or shortage of rainfall having a detrimental effect on the crop.

As a whole the district has a very much better maize crop than Mzimba, due in all probability to more satisfactory rains.

Finger millet (rupoko) cultivation can be said to cease south of the Dwangwa river and the lighter soils in the south are, therefore, in a much better state than similar soils in the North.

A few villages in the south do grow finger millet, but they appear to be those who have migrated from the north of the district above the rupoko line, and the crop is not generally favoured. Beer is usually made of maize alone.

Villages north of the Dwangwa, situated on the poorer sands, use gardens for two years only; the land the first year being subjected to a heavy burning for rupoko and a single maize crop being harvested the following season.

Phaseolus beans are not plentiful south of Kaluluma's village and in many parts, "ndiwo" for an adequate supply of vitamins presents a problem.

On the Bua and Rusa rivers, in particular, this shortage is acute.

Apart from a few groundnuts, and pumpkins and cucumbers in season, the leaves of sweet potatoes, together with those of the cow pea—which seems to produce better foliage than seed—form the principal "ndiwo" crops.

Culinary peas, tomatoes, onions and green vegetables such as cabbages and green leaved plants such as *Brassica juncea* are frequently grown on the dambo fringes where water is plentiful.

Cassava and sweet potatoes suffer much from the depredations of elephant and pig while the large numbers of birds render the successful production of mapira almost impossible.

Rice and nandolo are not relished and are hardly grown at all.

Tobacco is produced throughout N. A. Santhe's section, along the North bank of the Bua river, and up as far as Kazikitera in the west. It is generally sold at Mponela market.

As none of these villages have the benefit of supervision they generally possess very hazy ideas on its cultivation and curing, while their grading is such that much of the tobacco is often to be regraded in its arrival at the market.

Bananas and mango trees are not very plentiful but papaya is fairly common.

Castor oil plants, mostly self sown, are to be found in all villages. The oil is expressed and used on the skins of children.

Mulberries are grown in quantity in many villages. The fruit, which is very small, is disregarded, but the leaves are usually pounded and mixed with groundnuts for "ndiwo".

METHOD OF CULTIVATION.

Long handled hoes are most frequently used, but the short handled variety—up to now used by women only—seem to be coming into vogue.

Slightly heavier cultivation is practiced on dambo fringes. Where the black makandi dambos themselves are used large heaps are constructed—equal to a heavy cultivation—to avoid flooding. Dambos, however, are not cultivated nearly as much as they might be, owing to the extra work involved.

Gardens on the better soil stretches are seldom changed.

The frequent lack of *Phaseolus* beans and cow peas can often be traced to improvident habits. In a poor year for these crops everything harvested is eaten and no provision made for next planting season at all.

The system of communal fencing of gardens is much in use near the Fort Alston reserve, but these fences have to be particularly strong and entail much work. Therefore good soil is often abandoned for poor sands further from the reserve boundary.

SUMMARY.

Rice grown in the more fertile dambos in the south would safeguard many of the poor soil areas from danger of shortage in cereals due to a bad season and, for this reason, should be encouraged.

There appears little that can be done with the poor areas north of the Dwangwa and south of Kaluluma village, although measures against heavy burning for rupoko might assist in some measure.

An effort should certainly be made to popularise the pigeon pea (nandolo). An occasional crop on the better treated soils in the south would go far towards helping to maintain their fertility.

The close proximity of a large game reserve must, naturally, always be a threat to agricultural progress. The one way of helping to minimise this appears to be the concentration of village gardens belonging to those villages nearer the reserve boundary. This should make for stronger fencing systems.



10

Woodland thickets on higher ground above Vua alluvium containing *Combretum-Acacia* of several species.



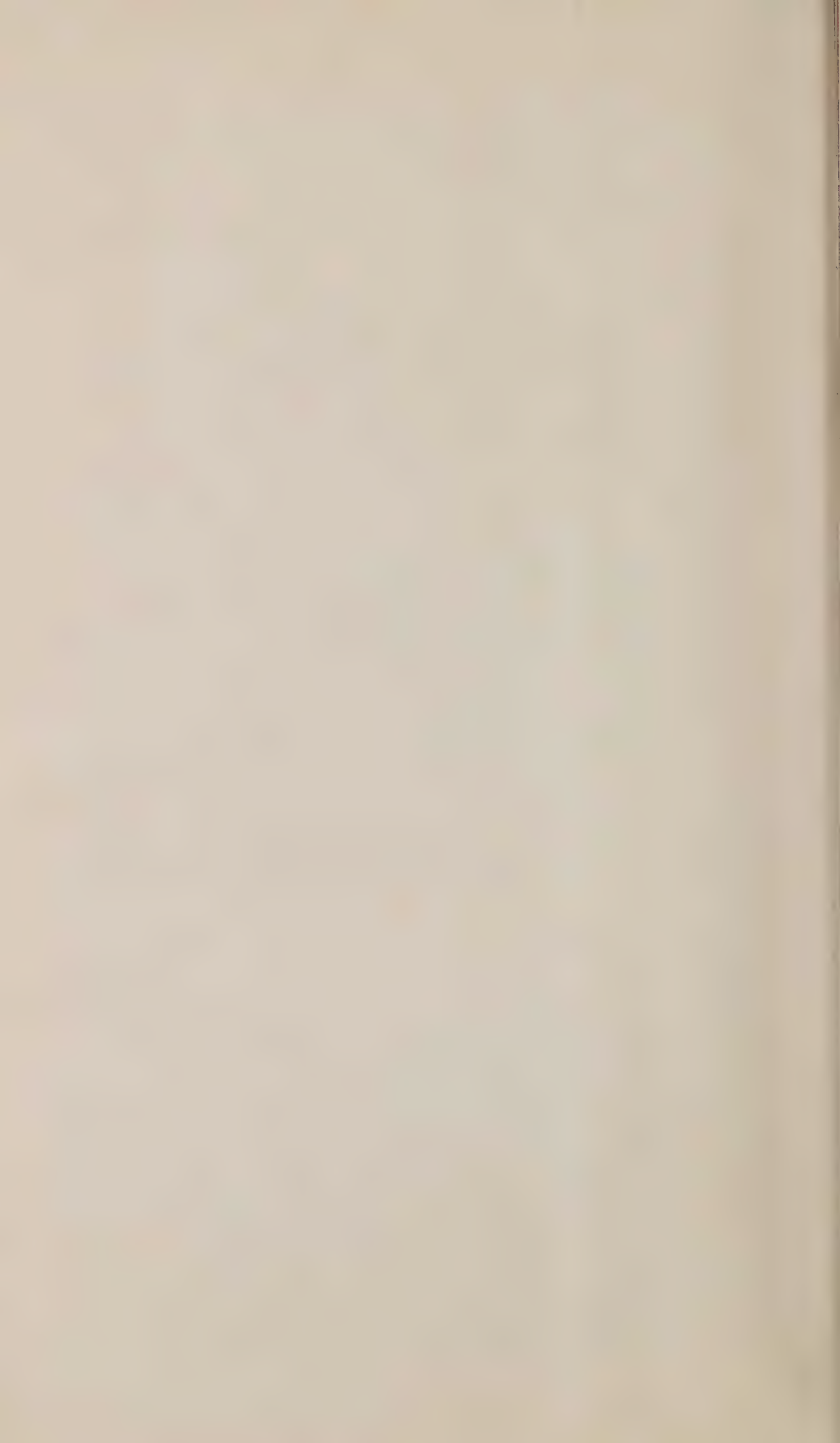
11

Stream bank with *Raphia* palms and *Combretum* typical of many valleys in West Nyasa. With tung oil (*Aleurites montana*) nurseries ready for transplanting. Tung oil should do well in many high-land areas of Northern Nyasaland.



12

Gully erosion in Kasitu Valley now found where many shallow depressions existed. Once the source of water supplies all the year round, they are mostly dry for over six months.



AGRICULTURAL SURVEY. PART 4.

THE HIGHLANDS OF SOUTHERN MZIMBA AND NORTHERN KASUNGU

by A. J. W. HORNBY and J. E. L. FENNER.

These highlands are important watersheds above the lower lying plains to the north, west and south and gradually merge into the grass steppe of the higher Vipya plateaux to the east. They include the important Forest Reserves of Mtangatanga, Perekesi and Chimaliro being 26, 70 and 38 square miles in size respectively. The north part of the Fort Alston Reserve, 400 square miles, also forms part of these highlands. Rivers and streams rising in these highlands, some of which in the flatter plains flow for only a short time during the year, comprise the Kasitu, South Rukuru and northern tributaries of the Dwangwa. The western parts of these highlands also form the watershed of tributaries of the Luangwa in Northern Rhodesia.

The elevation generally is over 4,500 feet above sea level falling gradually in the north to 3,700 feet in the highlands which form the headwaters of the Lunyangwa, Kafulafula and other tributaries of the Kasitu. The country here forms part of the so-called low level Vipya which is largely orchard country or open woodland with grasses prevalent on the more acid soils of northern Nyasaland.

The area comes under the Native Authorities Yakob Jere, Alifeyu Jere and partly under Mtwaro, Moses and M'belwa Jere in the district of Mzimba and partly under Kaluluma and Chulu in the district of Kasungu.

The whole of these highlands forms a definite agricultural division. Large areas are covered with red brown soils of varying degrees of fertility but with some good sandy and medium loams similar to those of the Likuni series of Lilongwe. The most infertile areas are in the Kasungu district.

There is a fairly large population with a density outside the forest reserves and north of the Milenji stream of 30 to the square mile.

The area is free from tsetse fly and this is pre-eminently the cattle area of Mzimba some 40,000 head being found in the grazing areas.

It is unfortunate that the area of over a million acres is so inaccessible. It is reached by the Great North Road from Kasungu and by a winding and difficult road from Nkata Bay over the southern Vipya plateaux. The distances from rail-head and from a lake port are such that only the highest priced products from this area can compete in the world's markets.

Another aspect of this agricultural division which must be carefully watched in the future is the damage which is being done by abnormal soil erosion. The erodibility of the soils is generally greater than those in the Southern Province and anyone who has observed gardens on slopes in these highlands, sometimes several acres in extent, must view with anxiety the amount of soil removed to lower levels during the rains. Even in the flatter areas near the Loudon-Luwazi road triangle there is extensive sheet erosion. Incipient and rapidly developing gully erosion is quite common where gardens are numerous and there is a large number of stock. Illustrations accompanying this report make clear the results of widespread denudation and unwise clearing. It cannot be said that the area is over-stocked but the position requires careful watching and it is feared that, as the area is so far from the beaten track of agricultural officers and supervisors, the evils of soil erosion will become greatly accentuated and lead to widespread distress.

Efforts are being made to develop the production of ghee and it is hoped that the animal industry may eventually be placed on a firm economic basis.

A summary of a series of reports on the highlands of southern Mzimba can now be given from the point of view of—

Water supplies.

The distribution of essential food crops.

Possibilities of economic crops in the area.

Areas requiring special attention.

It must be noted that the temporary migration of a large proportion of the male population has now become an established custom. The production of economic crops therefore has an additional obstacle to overcome, especially should the curtailing of this migration be the object in view.

Consequently an economic crop in this area must give a very definite assurance of reasonable and rapid returns to those willing to devote their attention and industry to its production. It is, in view of this, desirable that such a crop be conducted on a fixed price basis.

WATER SUPPLIES.

As will be gathered in the individual reports, these are, on the whole adequate. There are, however, certain areas where wells are badly needed.

Six to eight wells should be ample to supply the villages where supplies are poor and which have a long carry for the women.

M'mbelwa Jere section.

				Wells required
(a)	In the extreme north west corner near Moses Moyo village	...	...	1
(b)	Near and slightly West of M'mbelwa village	...	...	1
(c)	Near Mokocha village in the south west corner of the area	...	...	1

Mtwaro Jere section.

(a)	Near Chidimwa village on the Chesamu stream ; also about three miles north			2
(b)	Near Zebediah village on the Gonera stream, again near Timeyu, and also near Peters on the same stream	...	...	3

To estimate the number of wells required in the uninhabited areas of Mtwaro which are suitable for settlement is difficult in view of the doubtful extent of such settlement. There are numerous village water holes, mostly situated in dambos away from the main water courses, that call for improvement both from a supply and a hygienic point of view. These average some six to eight feet in depth and in an abnormally dry season must hold very little water. Were they increased to a depth of about ten feet and suitably lined they would be adequate.

In many of the wetter dambos simple dams would obviate the necessity for wells and provide a better and more useful water supply.

The improvement and increased reliability of the water supply should have a marked effect on the increase and health of the livestock in the district.

THE DISTRIBUTION OF ESSENTIAL FOOD CROPS.

Maize is undoubtedly the most important cereal food crop in the district.

The crop in Yakobe Jere's section is, in normal years, satisfactory and ample for the requirements of the population. The poor sand Lusituzi/Nchilawengu area, which is heavily populated, never satisfies its own requirements but in a normal year has no difficulty in obtaining supplies at a reasonable price from the adjoining more fertile soils. Even in a bad year sufficient maize can be purchased although the price is naturally somewhat higher.

M'mbwelwa Jere's section, on account of its relatively high population and preponderance of overworked, light loams, can never really be said to have a surplus. Better methods of cultivation are needed on these soils to keep the production from dropping even lower. The application of manure and a more thorough system of cultivation would assist considerably.

The same observations apply to Moses Jere's section which is, if anything, even more overworked and impoverished than M'mbelwa's.

The red katondo soils in this eastern part of Alifeyu Jere's section should be well able to supply the relatively small population.

The partially exhausted light sandy loams in the southern Kasitu valley, which represents the larger portion of Mtwaro Jere's section, seldom produce adequate crops, and the deficit is usually supplied by the alluvium sector between Njakwa and Mombwi hills and the Kasitu dambo.

It would appear from observations made that a great deal could be achieved by the issue of types of seed suited to the different climatic conditions, and experiments in this direction should go a long way towards solving the problem. Generally speaking, flints such as yellow kango should provide more reliable crops in the comparatively low rainfall areas on the western

border, while Potchefstroom Pearl and Hickory King should give more satisfactory yields in the east. Until such time as the fertile uninhabited areas have been made fit for settlement and settled, the export of maize from the portion of the district under review is to be deprecated.

Cassava. The distribution of this crop is very limited, although nearly all natives in the district like it. Its production, in any quantity is confined to the banks of the Lipachi river. There is absolutely no cultural reason for such a limited production, and one can only conclude that, being but a subsidiary article of diet to the greater portion of the population, sloth, in most cases, accounts for its neglect. There are, admittedly, soils that render even the ordinary type bitter, but these are the exception rather than the rule, and an increased production would certainly help to provide a standby in the event of the failure of the maize crop.

Beans are produced in varying quantities all over the district with the exception of the Lake stretch at Mwamlowe and parts of the Kasitu basin.

Phaseolus beans are by far the most favoured. They are grown in large quantities in Yakobe Jere and in parts of M'mbelwa.

Varieties are very mixed.

Places where they do not thrive, such as the southern portion of the Kasitu valley, are supplied by the more favoured areas. These beans play a large part in the local dietary.

There should be very little danger of a shortage as they are usually grown in excess of local requirements.

The white haricot variety is also extensively grown.

Dolichos and Black Velvet beans are not grown in this area.

Cow Pea is grown in large quantities in the central portion of M'mbelwa Jere's section and in much smaller quantities elsewhere. Is not nearly as popular as *Phaseolus* beans.

Pigeon Pea is not at all liked as a food crop.

An attempt should certainly be made to popularise this valuable rotation crop.

Peas. Ordinary peas are grown in small quantities all up the Kasitu valley where they often take the place of *Phaseolus* beans. The seed is, of course, very inferior and of extremely small size. Tomatoes also form an article of diet in many parts of this area.

Rice. There is a very large area suitable for rice culture. Providing, as it does, such a valuable standby in the event of the failure or partial failure of the maize crop, its cultivation should certainly be encouraged. At present except a few small patches in the Nkazi dambo in M'mbelwa Jere's section, it can hardly be said to be grown at all, and varying quantities are imported annually, both from Kota-Kota and Northern Rhodesia, to meet the requirements of the district. There would be a limited market for any surplus produced although it can hardly be classed as an economic crop. It definitely deserves attention from a local point of view.

Sugar cane is to be found in very small quantities on the Lipachi river in Yakobe Jere's section and in the hill dambos near Kansolo's village. It could be combined with rice cultivation in most of the dambo areas in the district where it should make a valuable addition to the food supply.

Groundnuts appear to be planted in about the same quantities and in the same areas as *Phaseolus* beans. Alternated with the latter they form one of the principal 'ndiwo' crops of the district. The local type of seed is very inferior. Even so an average yield of 1,138 lb; per acre, unshelled, off four quarter acre plots on Zombwe stock farm was obtained in 1937. Rosette disease does not appear to occur here, and the principal pest is a small field mouse.

Bambarra Groundnuts are found in small quantities in certain parts of Mtwaro Jere's sections but are of little importance.

Sweet Potatoes are grown in large quantities over the whole area and do well in most areas.

Ordinary Potatoes are produced on the few katondo patches near Mzimba Boma but do not appear to be used by the natives as an article of diet.

Finger Millet is the only species grown in the area. It is not generally popular as a food and is mainly used entirely in the production of beer. Only when there is an acute shortage of maize flour finger millet is used as a substitute. When cooked and eaten as flour it appears to produce some form of gastric trouble. A determined attempt should be made to replace this crop with other millets.

Gourds and Pumpkins are universally grown, the latter forming a valuable addition to the ordinary diet.

Sesamum indicum is produced in small quantities but is not relished by the natives. The same applies to Yams.

Kaffir Corn is also unpopular and hardly grown at all. The flour is not liked locally and the beer is said to be too weak.

Tobacco is grown in small patches in every village in the district. *Nicotiana rustica* which is frequently met with in the south was not found.

POSSIBILITIES OF ECONOMIC CROPS IN THE AREA.

Rainfall statistics are very incomplete and climatic differences in the hills in Yakobe Jere's country, in the red soil band on the Northern Rhodesian border, and in the hills above the frost line in Mwankhunikira's country must be large.

Generally speaking, groundnuts thrive, and can be produced in quantities, in the sections of Yakobe Jere, Alifeyu Jere and M'mbelwa Jere.

Haricot and Lima beans should thrive in these areas.

Castor oil plants are to be found self sown all over the area. The size and colour of the seeds varies greatly, but the issue of suitable oil types may be desirable. No stem borer was noticed on the various plants examined although in parts a certain amount of defoliation had been done by various caterpillars.

Sunflower and soya beans should grow well. The former does well on the heavier red loams of Yakobe Jere's section, while the latter would form a very useful rotation crop on the flatter lands in M'mbelwa Alifeyu sections.

Tree crops that should repay trial include Tung oil, Olives, Kabok, and Carob bean (*Ceratonia siliqua*).

The latter is doubly interesting being good cattle food as well as an export crop.

Two other products that should be worth investigation are dried egg products—albumin and dried yolk, and banana flour.

AREAS REQUIRING SPECIAL ATTENTION.

Waterless areas. These have already been dealt with. Areas where land is burnt for finger millet. The only way to deal with this menace to the agricultural future of the district appears to be an issue of a suitable substitute, combined with simultaneous legislation against heavy burning.

Yakobe Jere. Unsettled area. Measures must be taken against both pig and baboons.

Lusituzi-Ncilawangu area. Shifting the present large population to some of the better, unsettled soil strips and proclaiming this area a reserve is most desirable.

In M'mbelwa Jere section an attempt at some sort of reafforestation appears very necessary to meet the increasing shortage of poles and timber.

In Mtwaro Jere section along the central Kasitu Valley, erosion control is very urgently needed.

NOTE.—The description of soils in the poor areas of Kaluluma and Chulu has been given in part 3 and in view of the low fertility of such soils and the great amount of erosion in these higher areas north and south of the Chimaliro Forest Reserve, it is considered that there is little chance of economic progress and no more need be said at this stage.



13

Fields adequately protected against abnormal soil erosion by graded ridge terraces on the Nichols plan.



14

A well made Mangum ridge terrace to prevent abnormal soil erosion.



15

Young stock and compost manufacture, Zomba Experimental Station. This improved stock was bred from native cattle by the use of half-bred Friesland and Angus bulls.



16

Compost manufacture, Zomba Experimental Station. Heaps produced by the Indore method. Soils over wide areas in Northern Nyasaland where cattle are kept will soon have to be renovated by the addition of such organic matter.

AGRICULTURAL SURVEY. PART 5.

THE AKAMANGA AND SOUTH RUKURU PLAINS.

Report by Mr. J. E. L. FENNER on more southerly sections.

SECTION. Chinde Jere.

BOUNDARIES. Commencing at a point on the North Rhodesian border, due west of the south Rukuru-Mzimba junction; thence due west to the south Rukuru-Mzimba junction; thence by the Mzimba river to its confluence with the Warura stream. Along the Warura to a point on the old Mzimba-Njakwa road; thence following the old road in a northerly direction to a point due west of Hora mountain; from Hora mountain in a general northerly direction to a point on the Kasitu-Rukuru watershed; thence south west to Matola hill, and on to the source of the Kapanda stream. Along the Kapanda to its junction with the south Rukuru; thence in a straight line to Kasenga hill; thence in a southerly direction, following the North Rhodesian border to a point due west of the south Rukuru-Mzimba junction.

AREA. 500,000 acres

NO. OF VILLAGES. 240.

POPULATION. 24,000

TRIBES. Few Angoni — remainder of population Tumbuka.

ELEVATION AND NATURAL FEATURES. 3,500 to 4,500 ft.

Most of the section consists of broken plain land lying at about 3,500 ft. (or little over) and intersected by numerous dambos.

Isolated groups of hills occur in the central portions of the section and round these the country is more broken, rising to about 4,200 ft.

Solitary hills of higher elevation occur round the boundary.

As in other section of Pickford Jere the rise to the watershed on the North Rhodesian border is very gradual.

SOILS.

(1) *West of the South Rukuru.*

(a) The patch of red loam starting in the north west of M'mbelwa's section continues the entire length of the Rukuru in this area.

It appears to stretch from the North Rhodesian border to within about two miles of the Rukuru river, and is traversed by areas of lighter red sandy soils.

The subsoil is red.

(b) A strip; about two miles wide; running along the south Rukuru.

This is mainly composed of light sands and is of very poor fertility.

(c) The Rukuru dambo itself.

This varies in width from a few hundred yards to a mile or more.

Black alluvial soil with dark heavy subsoil.

(2) *Central Portion.*

(a) North central: Between Kapanda stream and Chamagi.

Poor sandy soils with light subsoil.

(b) Central: Between the Chamagi stream and the Luwenya.

Sandy loams; red and brown; of medium fertility. Heavily over worked in parts. Subsoil mostly red.

(c) South central: Between the Luwenya river and the Mzimba.

Poor sandy soils of indifferent fertility with large areas of infertile sands.

(3) *Eastern Portion*

(a) Northern : Poor sandy soils.

(b) Central : Light loams — a continuation of (b) in (2)

(c) Southern : Poor sands.

The entire area is intersected by numerous dambos of varying width and fertility.

The above classification is, naturally, very general.

Small patches of loams of medium fertility are to found in the poorer sandy areas and strips of infertile sands occur in the loamy stretches.

The general distribution of soils is, however, as indicated.

VEGETATION. Predominating :—

Brachystegia sp.
Isoberlinia paniculata
Isoberlinia globiflora
Brachystegia appendiculata

Other species :

Parinari mobola
Bauhinia thonningii
Faurea saligna
Uapaca kirkiana
Monotes africanus
Ziglyphus jujuba
Brachystegia mimosifolia.

The latter is plentiful on all infertile and excessively sandy areas.

TSETSE.

There appears to be no tsetse belt in this area, although tsetse may be found in the west of an area near the North Rhodesian border.

Although the south Rukuru is the only river marked as possessing a large dambo, all the streams in this section — the Mzimba excepted — are little more than dambos themselves.

ROAD MILEAGES.

Main road running through section : 20 miles. Chinde Jere to junction with main road : 15 miles. Chinde-Pickford road to Chinde's boundary : 13 miles.

WATER SUPPLY.

South Rukuru and tributaries.

Perennial :	Mzimba River.	
Seasonal :	South Rukuru.	Luwenya.
	Kapanda.	Luankosi.
	Chamagi.	Wanjazi.
	Zambozi.	Warura.

Also all tributaries of the above.

As has been already remarked, all these streams are little better than large dambos.

Those to the west of the south Rukuru dry rapidly, while the majority of those to the east run for ten months in the year and hold pools of water for the remaining two.

For the western dambos the water table appears to be too low for the use of the ordinary native water hole, and a large area is practically waterless for about six months of the year.

The prolificacy of dambos in this area should, however, render the construction of wells a simple matter.

The only other waterless area in the section — the portion enclosed by the eastern boundary and the Manturu stream ; down to Thanta hill — contains very poor soils and need not, therefore, be considered.

DISTRIBUTION OF VILLAGES.

The heaviest populated area is undoubtedly that along the west bank of the Rukuru.

These villages are all situated on the poor sandy strip adjacent to the river. They hoe their gardens on the fringes of the dambo, while a few penetrate into the margin of the red loam area. In the later gardens rupoko is usually planted as quantities of timber are available.

The poor sandy strip is also worked by those too indolent to go further.

There is a heavy concentration of villages in the light loam areas round the Native Authority Chinde Jere.

The entire southern and central portions ; where soils vary from poor, almost infertile sand to indifferent light sandy loams : are populated, but the villages widely scattered.

As stated above, the north eastern section is waterless and almost unpopulated but contains very poor soil.

CROPS.

Maize. Grown over the whole area. Does well on the edge of the Rukuru dambo and on the light loams, but rainfall appears to be an uncertain factor in this area.

Cassava. More generally planted than in M'mbelwa's section but not popular as a whole.

Finger millet (Rupoko). Universally grown. The area contains plenty of timber and burning is proportionately heavy.

Beans. The mbwanda types do well and are extensively grown over most of the area.

Groundnuts. Used a lot in this section. Quantities are dried and stored in small nkhekwe, which are made airtight and insect proof by mudding over. Both groundnuts and beans are kept for a considerable period in this manner.

Potatoes, pumpkins and rice are not generally grown.

Tobacco patches appear to do well west of Rukuru. Nearly all villages in this area cultivate a few cotton plants and manufacture their own sewing thread. The plants seen were well grown, though somewhat tall and the seed obviously very inferior.

Mangos and bananas are grown over the entire area.

METHODS OF CULTIVATION.

The soil is merely cleared of weed growth and the latter half buried and burnt.

Maize gardens on the dambo fringes receive a slightly deeper cultivation.

In the poor southern and central areas gardens are hoed on the light loamy strips. These are continued three miles or more from the villages and a great part of the year is spent in 'Chitandos' adjacent to the gardens, leaving the villages themselves deserted but for a few old people and children.

Gardens are seldom fenced as lions have cleared out most of the pig.

Dambos are hardly used at all and several villages visited in the north enquired about rice planting methods and asked where they could obtain seed.

There are large amounts of manure available in this area and some of the light loams round Chinde Jere would be greatly revived by its use.

SUMMARY.

Areas possibly worth investigating.

1. Strip up the North Rhodesian border.

Soil reported to be fairly consistent. That seen was red loam of medium texture and a light red sandy type. Subsoil red.

The only factor that appears to hinder settlement in this large stretch is lack of adequate water supplies.

2. A small area between the south Rukuru and the Wanjazi stream.

Soil said to be a dark loam of light texture and to grow good tobacco. Cleared by lions some years ago.

3. An area bounded in the south west by portion of the Luwenya stream and, roughly, circumscribed by Bundi, Thanta, Mazoza and Hera hills.

Said to be dark loam with dark subsoil and well watered. All villages moved from this area because of lions.

It is impossible to investigate any of the above three areas until after the fires have been through, as the grass is tall, the timber fairly thick, and there are no existing paths.

There is also a small area between the Luwenya and the Kaoundi—not shown on the map—that was traversed. It has been evacuated fairly recently owing to lions. The soil is a medium textured red loam with a red subsoil.

Lions appear to be a grave menace to settlement in all the more fertile areas, the thicker growth of vegetation affording abundant cover. Villages adjacent to these areas are enclosed within palisades and the cattle are always herded and grazed as near the village as possible.

CROPS.

The dambos in this section are broad and, in the main, appear to be fertile. Quantities of rice could be produced and cotton might possibly thrive in parts.

The area that seems suited to tobacco appears to be small.

An almost unlimited supply of groundnuts and beans should be possible.

Should a further investigation of the more likely areas be undertaken, soil samples from one of the larger dambos and from the areas indicated should be of interest.

Reports by Mr. B. C. G. CHARLES, Agricultural Officer of North Nyasa on the Nkamanga plain, the Hewe valleys and the Upper Rukuru valley.

THE NKAMANGA PLAIN.

The Nkamanga Plain is bordered on the north, east and west by the escarpment of the Nyika Plateau and on the south by the river Rukuru. It is some twenty miles long by about twelve miles in width at most, narrowing to the Njaka Gorge on the south-east and the Ruvira valley on the north-west. Generally speaking, it consists of a belt of extremely fertile soil running round the northern side from the Njakwa to Chekangombe hill, a ridge of lower fertility down the centre and another area of fertility to the south and west. The main belt is about twenty-three miles long, varying in width from two to four miles. It is watered by the perennial streams, the Rumpi, the Runyina and the Luvira. The central ridge is of lower fertility but suitable for the growth of finger millet, groundnuts and small millets; water, however, is scarce. To the south is the valley of the Rukuru, of high fertility, and the Rusano area watered by the Mwazizi.

CLIMATE.

The climate is probably very similar to that of the Lower Henga Valley in that considerable extremes of temperature are met with. Very considerable frost damage was experienced this year in June and July everywhere on the plain, with the possible exception of the central ridge, but native opinion has it that such cold is unusual. In the dry weather the maximum day temperatures must rise almost, if not over, the hundred mark, though no figures are available as yet. From personal experience it has always seemed very much hotter at Nkamanga than at Karonga during the latter months of the year. Nights, however, are always cool. High winds are an unpleasant feature. Rainfall is probably between 40"—50" for the wet season and between 2½"—5" for the dry weather.

SOILS AND VEGETATION.

There is considerable variation in soils and in vegetation. From Njakwa west for about six miles is a belt of very fertile red soil with a slight sandy texture carrying an almost pure stand of fine Mtete trees (*Acacia* spp.). It is about two miles wide and runs down to the Rukuru and merges with the *Borassus* association there. The foothills further west intrude a band of poor gravelly soil for a mile or two carrying poor *Brachystegia* scrub, which then emerges again as

good land carrying *Acacia* dominants. Further west still is reached the broad belt of Nsangu and *Borassus* bordering the Runyina river. This belt of great fertility, consisting of black alluvium with a high clay content, is approximately four miles wide and runs on either side of the Runyina for quite twelve miles. The Nsangu trees are exceptionally large. At the north-western edge of this belt the Ruvira stream flows into the Runyina and there is a further belt of high fertility along its course some ten miles long and a mile or more wide in parts. There a number of small villages at its headquarters in the hills.

The relatively infertile central ridge carries gardens of finger millet but few, if any, villages on account of lack of water. The following were among the trees noted on the ridge:—Muntukutu, Chigule (He), Mpolya, Mquaji (He), Mususyu (He), Mnanyata, Ulimbu (He, birdlime), Mwangali (He, candelabra), and Matwowa (He). To the south-west is the fertile Rusano area with an association of Nsangu and other *Acacias* and about twelve square miles in extent. Further to the south is the Rukuru valley with the lakes Kasuni and Bowi, but by now the Nsangu and *Borassus* association has faded out and its place taken by Mtete and other *Acacias*.

CROPS.

Over the Nkamanga Plain as a whole excellent crops of maize can be grown, though this year early cessation of rains appears to have reduced the yield considerably. Groundnuts and beans do well and could be produced in quantity if the inducement was sufficient. Tobacco should do well, as should cotton. A small patch of cotton was examined at the central school at the village of Chikulamayembe, the Native Authority, and appeared to have born well and to be free from stainer and bollworm.

THE HEWE VALLEY.

The Hewe Valley is a small fertile area on the banks of the Hewe River in Katumbi's district. It is cut off from the Nkamanga plain by a spur of the Nyika foothills round the headwaters of the Mwazizi stream. It consists of a strip of alluvium about a mile to a mile and a half wide and perhaps ten miles long. There is also a small fertile valley to the south by the village of Msawawo, a few square miles in extent.

CLIMATE.

Very similar to that of the Nkamanga plain but perhaps not quite so hot, though there are no figures as yet from which to quote. Considerable frost damage occurrence this year in dambos to bananas and cassava. Rainfall probably between 40"–50" for the wet season and 2½"–5" for the dry season. The altitude is about 4,000'.

SOILS AND VEGETATION.

A rich dark alluvium on the Hewe banks carries an association of big Nsangu trees and other *acacias*, but no *Borassus* palm. Fringing this is a transitory belt of reddish sandy katondo carrying large Mombo, Mtanga-tanga, Mlombwa, Nsoro (*Pseudolachnostylis maprouneifolia*), Muntukutu and Mpururu (*Terminalia sericea*). This latter belt again degenerates into poor Mombo (*Brachystegia*) scrub suitable for finger millet gardens only under shifting cultivation.

CROPS.

The crops grown are similar to those of the Nkamanga plain, i.e. maize, beans, groundnuts, and finger millet. Rice should grow in the dambos and tobacco should do well; a garden of cotton was inspected at Katumbi school and it appeared to have born fairly heavily and to be very free from stainer and bollworm, and to have been unaffected by the cold weather.

DEVELOPMENT.

Beans and groundnuts would probably afford the best medium of development, though there is a long carry over the hills before even the Nkamanga plain is reached. This is an area in which production of beeswax might well be stimulated.

THE UPPER RUKURU VALLEY.

From Lake Kasuni southwards is a very fertile strip of land on either bank of the Rukuru river extending for some twelve miles to the junction of the Rukuru and the Luwewe stream. This is largely in section of Pickford Jere in Mzimba where the villages are concentrated along the South Rukuru and reach a high density of 50 to the square miles of cultivable land. Thence up the Luwewe for about five miles and up the Rukuru to its source near Loudon Mission, though the fertility gradually falls off.

CLIMATE.

Very similar to that of the Nkamanga Plain, with considerable extremes of heat and cold. Definite frost damage this year to bananas and cassava, but this is unusual. Rainfall probably between 40"—50" for the wet season and between $2\frac{1}{2}$ "—5" for the dry season. The altitude is approximately 3,800'.

SOIL AND VEGETATION.

Good dark alluvium along the river banks carrying a practically pure stand of Mtete, but with very few, if any, *Borassus* palms. The soils degenerate, as in the Hewe valley, back through good reddish katondo to poor *Brachystegia* scrub.

CROPS.

Maize and finger millets do well, as do groundnuts; beans not quite so good as in the Nkamanga plain. Bananas are fair and some cassava is met with.

DEVELOPMENT.

Groundnuts would probably afford the best medium for development of production. It appears that rice was tried in the dambos and did well, but it later died out through lack of demand, it being unpopular locally as a foodstuff.

There is a fair amount of good land that has not yet been developed, mainly on the north and west bank of the Rukuru and the north-east bank of the Luwewe.

PART 6.

THE NYIKA AND MISUKU MOUNTAIN AND HILL AREAS.

These areas have been surveyed by Messrs F. Barker and B. C. G. Charles, Agricultural Officers in North Nyasa in 1930 and 1937 respectively. Their reports are given below. Also a report by the acting Chief Veterinary Officer on the Nyika is appended.

THE MISUKU AREA OF THE NORTH NYASA DISTRICT FROM THE POINT OF VIEW OF NATIVE DEVELOPMENT BY MR. FRANK BARKER, C.D.A. (Edin).

The Misuku area is situated two day's march to the north west from Karonga. During the rains it is nearly inaccessible and at no time in the year can it be reached other than on foot so rugged and hilly is the nature of the country.

GENERAL DESCRIPTION.

After crossing the Ngerenge rice flats nearly at Lake level the low foothills commence which are covered with *Brachystegia* savannah and open woodland. Broken hilly country to a depth of eight miles extends north and south till the northern tributaries of the Lufira are crossed. In one of the better valleys are the villages of Kasakora and Pwamaramba. This area may be termed the intermediate foothill area with open woodland of the *Brachystegia-Uapaca-Bauhinia-Protea* type. The altitude is from about 3,500 to 4,000 feet. North west of this area around Misuku and Kasumbi, 5,100 feet, are good soils and misitu or mountain evergreen forest caps on some of the highest areas. European estates were found around these more fertile hill areas. From these areas, the highest peak of which is Wanda, 6,176 feet, the country descends northwards to the Songwe and is covered with *Combretum-Acacia* woodland. The soil is comparatively poor until the valley of the Songwe is reached where towards the north west a narrow strip of good alluvium is found. The Mugesse ridge however drops steeply from the rain forest area to the Songwe. East of Wanda and Vivona hills the country is again covered with *Combretum-Acacia* on the better soils and open *Brachystegia* woodland on the poorer soils. The Kaseya river is then met with where the village of Mwenifumbo at 4,000 feet is found with gardens on a narrow strip of good alluvium. To the west of the Kaseya and the Mitimbi towards Fort Hill, the *Combretum-Acacia* with isolated palms continues to the western border. North of this area are grass steppes on the higher lands with poor *Brachystegia* woodland covering the red lateritic soils till the narrow alluvial belt of good fertility indicates the course of the Songwe from Kamime and Nyondo to Chinga village on the Kaseya. Here again a narrow alluvial belt is found proceeding southwards. These belts are termed in the vernacular viwanda.

The true Misuku area lies at an altitude from 4,000 to 7,000 feet and is covered generally with grass steppe at the higher elevations, with shrubs, bracken and stunted trees. In the sheltered areas provided by the many stream beds are the villages and better tree growth. The misitu on some of the highest crests at some 6,000 feet have been referred to. These caps of rain forest are carried down a certain distance of the sides of the precipitous gullies. Tree ferns and buttressed roots of the napalali trees are characteristic of this vegetation.

It is noteworthy that in places the margins of these forests suggest that they are being destroyed through human agency but this is referred to in a later paragraph of this report.

RAINFALL.

The rainy season throughout the area traversed is very definitely November and December to May/June with the exceptions of the Songwe area at the lower elevations and the western area of David Mwamalanga and Poloko where the period is December to April/May whilst that of Kapoka, Chalambweni and the Kawenji valley south west of Kasakora is December to April/May. This information, although of native origin is considered reliable as these months have been consistently named by the many natives in different villages who were questioned on the subject. The high winds were particularly noted which blew, reaching almost gale force at times, and how surprisingly cold they were for so late in the season as mid-September.

The strength of these winds is reflected by the wind-shorn and stunted appearance of the few isolated trees which remain in parts and also on the forest outskirts particularly on Vivona hill crest and slopes.

Temperatures must show considerable variations and severe extremes occur. Mr. G. H. Lilford has registered 48° at Mugesse Estate.

It is interesting to note that in certain parts of the Misuku ground frosts occur in the months of June and July—the native recognises this frost under the name of cifwufi.

THE FOLLOWING NOTES ARE NOW MADE WITH ESPECIAL REFERENCE TO THE POSSIBILITIES OF COFFEE CULTIVATION.

From the outset it is of course understood that the Misuku country is not ideally suitable for coffee growing on account of the long and well defined dry season of about 5 months which is a feature of the country and coffee or any other crop will sooner or later react to those conditions.

A hardy plant such as coffee may no doubt appear to thrive for a number of years but in the long run the climatic conditions unsuited to it will more than likely be reflected in increasingly diminished yields or in the greater susceptibility to disease and insect attack due to lowered powers of resistance brought about in its fight to survive in a climate foreign to it. A reference to rainfalls and their distribution in the coffee producing countries of the world indicates how unfavourably the Misuku compares with them from that standpoint. The Tukuyu area nearby makes suitable comparison.

There is visible evidence however that coffee does grow well, and appears to thrive in pockets of land where the soil is deeper, richer and more retentive of soil moisture in the dry season without waterlogging in the rains but it is not known nor is it yet safe to say with what lasting degree of success.

These adverse aspects in respect of contemplated coffee culture in the Misuku are mentioned not with the object in view of condemning the project but merely to indicate that results commensurate with more or less freak conditions must be anticipated therefrom.

Alluvial Bottoms. These are known by the Asukwa natives as viwanda* and the quality of them varies considerably; many not being true alluvials in the strictest sense of the term applied.

I have estimated the total acreage of those viwanda and extension areas for native coffee cultivation to be 151 acres and it is to be noted that almost without an exception they are cropped under various food crops during winter and summer seasons.

ESTIMATED ACREAGES.

TOTAL ACREAGE	...	...	...	...	...	178	acres
Acreage viwandas	...	...	...	...	...	77	"
„ feasible extensions by simple terracing	...	...	...	...	...	44	"
„ other lands requiring terracing	...	...	...	...	...	27	"
„ for minor viwanda area	...	...	...	...	...	15	"
„ viwandas in less promising area	...	...	...	...	...	10	"
„ extensions by simple terracing to the former	...	...	...	...	...	5	"
Average acreage of major viwanda gardens	...	...	...	...	...	.38	"
„ „ „ „ „ „ plus extensions to same	...	...	...	...	...	.61	"
Estimated size of average potential peasant coffee cultivator's garden would be 50 plants (to represent about 1/3rd to 1/4th of the average garden within the communal Viwandas of his village).	...	...	...	...	...	.10	"
The able-bodied male population is roughly 1200—therefore if each of these grew coffee each would then cultivate approximately	...	...	...	...	...	.130	acres.

Viwandas run in a catenary or chain formation and I do not include in my acreages above the extensive banana plantations which are a feature of most bottom areas.

Many more viwandas exist but these I have ruled out for one or more of the under mentioned reasons.

They flood in the rains and can only be put under crop in the dry season.

During the rains only are they any use for cropping—they are too dry in the non-rainy season for this purpose.

* Viwanda may be taken as the Chisukwa equivalent of the Mang'anja word madimba. Chiwanda and dimba are the singular.

Springs, flushes or seepage cause boggiess which persists the year round.

The water table so high at but a foot down that cultivation in the dry season is carried on only by the practice of making tsinde (high mounds) which keeps the roots out of water and allows of moisture supply by capillary action. Lands other than viwanda available for native development.

The immediate slopes of those viwandas which are not too steep in gradient could be terraced and this is allowed for in the table of estimated acreages.

There now remains only the hill slope areas of the Misuku which are not considered as being suitable for many perennial crops for the reasons given below some of which seem to be thoroughly well demonstrated in the hill-slope culture of coffee at the estates of Mubula and Mugesse.

There does not appear to be the requisite amount of moisture to carry the coffee plant satisfactorily through the dry season.

Certain foods, essential to the coffee plant e.g. potash, phoshates and organic matter, are either not present in sufficient quantity or are not readily available for the plant.

Many of the hill-slope soils have the "cold" appearance associated with an organic matter deficiency.

The amount of surface soil in parts is extremely shallow and it also looks as though "panning" might readily occur if incorrectly cultivated.

Terracing would necessarily be an inseparable essential to hillslope cultivation of coffee under misuku conditions and to lay these out with the degree of accuracy necessary on slopes of 1 in 1½ and often much greater would be outside the powers of the average native, and, even if feasible the danger of producing a toxic condition of the soil by subsoiling (in the construction of terraces) would be present.

It would therefore seem that if a coffee industry is to be fostered the viwandas offer the major possibility for a commencement. The area of potentiality, will be about 100 sq. miles and lies between the parallels of Latitude 9°30' and 9°45' and degrees of Longitude 33°15' and 33°36'.

It is often found difficult to get local Asukwa natives to agree on the names of different hills and it was by no means rare to meet with a native who was almost entirely ignorant of the names of prominent hills within a comparatively few miles of his hut. (The names mentioned above can be found on the general map of northern Nyasaland).

In some respects it is to be regretted that the misuku native would appear to have gained the impression from some quarter that his country is an ideal one for coffee culture—at least that is the impression gathered throughout the district. Whilst their outward manifestations of enthusiasm are much to be admired it is perhaps a little unfortunate that they incline to rather exaggerated ideas of the financial possibilities in coffee culture. Many partial successes are bound to be a feature of a coffee growing industry under Misuku conditions and if Government fosters the project those natives who do not meet with the measure of success anticipated will not only be disgruntled with themselves but also with those who actively supported them in their venture.

The present state of the coffee market will of course be considered carefully in view of the tremendous surplus crop held by Brazil and the rest of the world. It seems undesirable at the moment at all events to stimulate further production on such a scale as will still further adversely influence an already dull market.

It is suggested that under all circumstances and in view of the conditions which exist within the area that any hope of an establishment of native coffee growing on really sound lines is to station an officer in the Misuku to work solely on the promotion, and the supervising of the industry there. In this connection it will be remembered that the Misuku is well nigh inaccessible from Karonga during the rainy season and also that in the dry season travel from one small planting area to another is arduous to a degree on account of the difficult type of country.

Under the guidance of a European stationed in the area the more easily developed viwanda areas could be exploited for a commencement and the slope area could then, after a close and more intimate study of local conditions, come under consideration.

It cannot be stressed too strongly how very keen the Misuku native is to take up coffee culture and it is believed that peasant coffee growers cultivating the crop within viwanda areas could anticipate a reasonable return from his energies for a limited period of years.

If the whole of the estimated area were supervised by a European then there are possibilities of a 30 ton crop from 3-4 year old coffee. This figure might even be improved upon but at the same time there does exist the very definite risk due to partially suitable conditions and whether Government actively fosters the industry, or otherwise, prospective native growers should in my opinion be very clearly informed on that score.

PRESERVATION OF WOODLAND GROWTH AND ECONOMY IN FUEL SUPPLIES.

The call for attention to forestry matters in the Misuku generally is everywhere strikingly apparent and commentaries may be allowed under this head.

It is considered that the little forest land which does exist should be conserved without delay for the inroads made by continued pollarding and pruning of trees, to obtain firewood, material for charcoal burning, material to burn on the sites of finger-millet gardens are glaringly evident both in the Misuku proper and especially in its more forested fringes. For example in the Kaseya river valley it has been estimated from gardens prepared and ready for burning that brushwood up to 2" diam. is burnt at the rate of as much as 1000 yards to the acre to supply the necessary quantity of ash. Reserves of some existing hill top forests could be made and re-forestation carried out wherever favourable.

Such a measure would tend to even up temperatures within the area so influenced and would likewise assist in rainfall distribution and precipitation both features of considerable importance to the district. It would seem somewhat theoretical to suggest that the Misuku was once relatively well represented by the tree bearing that name (Misuku *Uapaca* spp.) and that the headmen, and his district, originally took their names on that account. It is suggested that the cultivation of finger millet vern. malesi (*Eleusine coracana*), as practised by the native is the chief cause contributing to the denudation of forest lands which has gone on in the past and still continues in those areas where trees are still available.

The native appears to realise how badly off he is for forest lands and they should react readily to a scheme of re-forestation.

If the Forest Rule that cultivation of land within eight yards of a stream bank is prohibited were applied to the Misuku district then a very appreciable proportion of viwanda areas would be debarred from the native for cultivation.

NOTES ON VARIOUS CROPS.

Finger millet. The popular crop for both beer and food is finger millet *Eleusine coracana* which is evidently so exhaustive of Misuku soils that natives often find they can take but one crop from a garden for a good return. This would seem to indicate the presence of only very limited quantities of available nitrogen and minerals in the soil. When the annual loss of soil through erosion on the steep slopes, winds also playing a part in these unsheltered areas, is added to the impoverishment through the cultivation of finger millet it will be readily seen that new gardens are continually being sought after and opened up. Where the absence of trees is evident the cultivator goes far afield to obtain supplies wherewith to burn his gardens. Garden areas tend to progress higher and higher up the hill slopes and so the process of soil deterioration goes on.

It must be said of the Asukwa native that he does follow out a rotation this normally one year, or two at the very most, finger millet, followed by beans *Phaseolus vulgaris*, followed by maize, followed by sweet potatoes. The garden after these four or five years of cropping is usually worked out and is allowed to go fallow for a period of years after which it may, or may not, support another malesi finger millet crop. A new method of threshing finger millet is recorded. The ripened heads of grain are totally immersed in a pool of water provided for the purpose. Retting, as the process actually is takes some days to complete and when the heads are washed in a basket the grains come away freely. These when washed clean are spread out thinly and thoroughly sun-dried ready for storage. Natives inform me that germination is in no way impaired by this novel procedure. That the Asukwa is aware that his soils require organic matter is obvious from his practice of when weeding his finger millet gardens he uproots and collects the weeds into heaps within the garden to rot. These heaps of rotted material are then spread when he prepares his garden for the crop of beans. Digging in deeply all crop remains such as maize stalks, bean vines etc., wherever possible.

Wheat. Trial plots of this crop by natives and Europeans alike suffer somewhat from leaf rust (*Uredo* sp.). Whilst the growth is good the grain of the varieties grown does not ripen well. There is large scope for work on different varieties and on manuring this crop.

Root Crops. While sweet potato is grown all over the areas in question there is also a root crop which is grown all over northern Nyasaland and whose cultivation in the hill areas is worthy of note. This is mbuye (N) *Coleus dazo*, also called nyumbu (Y) and numbu (T). The roots are grown on mounds which are surrounded by trenches about ten feet apart. The shoots are usually planted in holes and when growing well they are earthed up. The yields are rather poor but the roots are palatable and likely to contain food factors of value. The method of cultivation might easily be made to serve as an arrangement to minimize soil washing.

Note by Editor.—The part played by finger millet in the agriculture and so called shifting cultivation has aroused considerable interest lately and the following facts concerning its cultivation and the possibility of improving or eliminating altogether the burning system so largely practised in the northern areas may be of use.

The burning system is now well known and may be only briefly referred to. Comparatively early in the dry season loppings from tree and coppice growth are carried to the acre or so of virgin soil or soil which has been rested a few years which is the site of the garden for growing finger millet and other crops during the following season. The work continues till October and when rains appear very near the layers of branches, leaves, etc., which often reach a height of 30 inches are set fire to. The ashes when mixed with a little soil which can be so easily pulverized after the burning make an excellent seed-bed and good germination results after sowing with the first heavy rains. Weeding is reduced to a minimum. The system has many variations but it is conceded that there is a great wastage generally of timber resources and that soil erosion is accelerated by the extensive deforestation and the radical change in the structure of the soil and subsoil.

The varieties of finger millet as known in northern areas and with the Nyanja equivalent are as follows:—

Chamafuta	...	...	...	=	Kataya	(N)
Katuatua	...	...	...	=	Chikonondo	(N)
Makonde	...	...	...	=	Manga-wa-nkango	(N)
Chapata	...	...	...	=	Mulakalika	(N)
Ntanga	...	...	...	=	Ntanga	(N)
Kabubu	...	...	..	=	Kabubu	(N)

All these types are growing under greatly varying conditions on the Zomba station, and it is unlikely that there is any material difference in soil requirements or in removal of plant food elements by any one of these varieties.

All the above varieties are growing well on unburnt soil in only a medium state of fertility without fertilizer and the following method of cultivation should receive consideration in certain districts as an alternative to the extreme destruction of valuable timber resources.

(a) Small nursery beds should be burnt with rubbish and brushwood as in the case of tobacco seed-beds. In November or December seed of millet should be sown for transplanting in the following January or February respectively. Seed-beds should be 30 feet long by 1 yard wide. Such a bed should plant out one half acre. Weeding should be carried out if necessary.

(b) In dull cloudy weather plants should be pulled from the beds and conveyed to the prepared field. This field having been well cultivated towards the end of the previous rainy season but *not burnt over* and at the time of planting out should be quite clean. Holes should be made with a light hoe 18 inches by 18 apart and only one plant should be placed in each hole—this spacing will facilitate weeding and hoeing. In certain areas some difficulty will be experienced by workers in planting and supplying in a weedy field in distinguishing between finger millet and *Eleusine grass* (*Eleusine indica*) syn. Chigombe (Y) Mphusa (N) but if weeding is commenced when the plants are about four inches high, the latter may be distinguished and pulled out. This method is practised with slight modifications by natives in the Southern Province and the objection can be seen to the burning of rubbish and small amounts of scrub growth. The nurseries so formed may be in the middle of a field and the plants may go on to mounds on which maize and beans are also growing.

Kraal manure cannot be used in the cultivation of finger millet as it always introduces the weed *Eleusine indica* which is stronger than *E. coracana* and chokes it.

Indore compost as manufactured on the lines of Howard and Wad can be used as all weed seeds are killed in the process. Land which has been early cultivated so that weeds and grass have not seeded may be manured with this compost and a good yield obtained.

Our experiments have shown the value of green manuring such as digging in sunn-hemp and in growing leguminous crops such as soya beans.

The value is appreciated by certain tribes who have indefinite rotations of fallow, millet, beans and maize, millet, sorghum and groundnuts, varying with the elevation and rainfall but it is considered that a proper use of the leguminous crops in the rotation might be easily demonstrated and a better system of millet cultivation initiated. Artificial fertilizers are of very little use in dealing with this crop but experiments with lime, phosphate and potash to estimate exactly what part ashes play in determining the good yields obtained in the burning system. It is most likely that the main effects of burning are in improving the physical condition of the soil and in partial sterilization effects.

To sum up, efforts should be directed to improving the agriculture of tribes who are destructive of large areas of timber for cultivating finger millet, pumpkins, etc., by defining better rotations which will maintain good yields without any burning of gardens, replacing finger millet by other cereals which are less exacting in soil requirements, and by education showing the value of compost heaps, green manuring and correct terracing which may replace indefinite mound cultivation.

SHORT REPORT ON THE HEWE AND NYIKA PLATEAUX

by Mr. B. C. G. CHARLES, C.D.A., A.I.C.T.A., who has also forwarded soil and population maps.

From Katumbi to the northern edge of the Vwaza Marsh and on to the Rhodesian border and then south along the border. Chuka is a small village on the north-eastern edge of the Vwaza and Mparura a small village on the north-western edge of the Marsh, neither being of any importance and eking out a poor existence on the fringe of the *Brachystegia*.

About thirteen miles south of Mparura is a slightly larger village, split up into several parts, on the Hungerawe stream which is a series of pools in the dry weather. The village of Moa is again of no agricultural importance.

About twelve miles south is Makaroti and a further twelve miles south is Masapa, on the Luwewe stream. These villages are small and of no importance, while the Luwewe drains the Vwaza Marsh and flows into the Rukuru. A series of pools exist in the dry weather.

Back north are Chantara, Kutamanji and Solekere again all of no importance.

This whole area is more or less covered with *Brachystegia* scrub with a thick patch of *Tsanya* between Moa and Masapa, all along the Rhodesian border. Of no agricultural importance whatever, though something might be done with beeswax here. The people have no hives but take honey from holes in trees; they eat the honey and throw away the wax as they say that there is no market near them for it. It is understood that one firm will be buying wax at their stores on the North Road and it is proposed to set going propaganda for the making of hives and the collection of wax.

A ulendo was undertaken on the Nyika Plateau. The area visited was the one to the south and south-west where there is a certain amount of habitation, and where there are a number of small villages. The Nyika was climbed immediately behind Nchenachena and two days were spent crossing the high open plain at about 8,000' before the village of Majumbura was reached. This village is at about 6,800' and maize, finger millet, English potatoes, peas, beans, are grown. There is also a number of small cattle. There is a light scrub of *Brachystegia*, *Nguti*, *Mwanga* all very small and wind-swept. This village overlooks Katumbi and the Hewe. A return was made to the southwards along the hills overlooking the Nkamanga plain via the villages of Chidumuka and Tete. Cultivation in these small villages is shifting in the extreme and agriculturally, they are of no importance. The production of beeswax is probably their main line of existence, combined with hunting. It is extremely cold at this height and only the Wapoka people can stand it.

On the main Nyika Plateau there is no habitation and natives only visit it for hunting and for the taking of beehives. It should be perfectly possible to ranch cattle there, as well as sheep, as it is well watered and there are numerous small sheltered valleys, with clumps of trees here and there.

A grass is present which is said to be poisonous to cattle but there is apparently not much of it.

NOTE: This has been identified as *Setaria grandis*. Tests were made with feeding dry hay made with this grass to cattle on the Zomba Experimental Station. No ill effects were obtained.

THE NYIKA PLATEAU WITH SPECIAL REFERENCE TO ITS SUITABILITY FOR CATTLE AND SHEEP

by Capt. J. M. CULHANE, M.R.C.V.S. May 1926. Revised 1937.

The high Nyika plateau which lies at an average elevation of from seven to eight thousand feet above sea level is situated in the northern part of the Mzimba district. It is surrounded on all sides by higher ground rising in places to peaks over eight thousand feet in height. On the east or Lake side these hills descend somewhat precipitously to the Fulirwa plain and the Lake shore and the Plateau is not visible from this direction. On the south the outer hills here of less altitude bound the Chikulamayembe or Mkomanga plain. To the west there is a gradual slope towards the Luangwa valley in North Eastern Rhodesia and on the north the boundary is formed by the high ground south of Ntalire's village. The Nyika plateau proper is roughly speaking thirty five miles in length from north to south by twenty miles in width from east to west. These figures are however only approximate but as the Plateau has been thoroughly surveyed the correct acreage should be available.

The greater part of the Nyika Plateau proper consists of well defined undulating or rolling country covered with short grass and rising in places into more prominent hills. The northern and middle thirds of the Plateau are essentially of this type of country. The southern portion which is on a lower level is more broken in contour presenting some well defined hills and large outcrops of rocks and contains more timber than the areas to the north. The whole Plateau is very well watered, in this respect I should say that it is one of the most favoured areas in the Protectorate, the chief streams being the Chelinda flowing south to the Southern Rukuru and its tributaries. There are numerous streams running through all parts of the Nyika, some disappearing underground in places and all providing an abundant supply of cold crystal clear water. There is also a small lake in approximately the centre of the Plateau.

The greater part of the Plateau is covered with short grass growing in close tufts.. Bracken which is common on the outer hills is rarely found on the Nyika proper save in the southern area where in places, chiefly in the hollows amongst the hills, long grass also grows.

Timber is very scarce on the Plateau such trees as occur being chiefly found in small clumps at considerable intervals apart. They are mostly small to medium-sized evergreen trees with twisted stems sometimes draped with lichen and would appear to be useful only as fuel. Some junipers of considerable size are to be found on the eastern border.

Game is fairly common, amongst other species I noted eland, roan, zebra, reedbuck and bushbuck. The presence of this game is of course associated with that of carnivora which I am informed are not uncommon.

The climate of the Nyika would appear to be that of all high tropical plateaux. The nights are cold, often intensely so and frosts are reported to occur frequently. During the nights which I spent on the Plateau I experienced a greater degree of cold than I have felt in any other high part of the Protectorate and of course later on in June and July the cold becomes greater still. The rainfall would appear to be rather heavy and the Plateau is often for days even weeks at a time in the dry season enveloped in thick mist. On the other hand days of perfect weather occur when the sun shines warmly from a cloudless sky, the air is crisp and tonic and one is hardly conscious of a sense of fatigue.

The greater part of this magnificent country is uninhabited, such native settlement as exists being principally in the southern tract. The natives who are variously styled Anyika or Apoka are a branch of the Henga people. Their chief crops are maize and beans but they also grow wheat which appears to do well and which they bring to Livingstonia for sale.

Considering the Nyika Plateau from the point of view of livestock I am of opinion that it is better suited to sheep than to cattle ranching. The great rolling tracts with their covering of short grass appear to be ideal for sheep. The entire region seems adapted to sheep raising. I also traversed country on my journey amongst the hills before reaching the Plateau which should be considered in this respect a fascinating country of rounded hills, covered with short very green grass and dotted with numerous clumps of thick timber.

The water supply as I have already pointed out is abundant though in the case of sheep with adequate grazing this is not of prime importance. Liver fluke is to be apprehended in the tracts of land along the streams where even in the dry season the ground is marshy and boggy in places.

As to the grazing, whilst I think that at certain times of the year the Nyika Plateau could carry one sheep to the acre I consider that an estimate based on the ratio of one sheep to two acres would be safer to work on. As the acreage figures should be available the number of sheep the Plateau is capable of accommodating can be approximately arrived at.

The danger from carnivora is of course great and suitable measures for dealing with these pests would have to be adopted before profitable sheep farming could be undertaken.

The lack of timber is also a drawback but there is still a fair amount on the hills surrounding the Plateau.

As to the suitability of the Nyika for the various breeds of sheep the rainfall has to be considered. I do not know the figures for the average annual rainfall but it can not be less than that of the Lake shore i.e. about 50 inches and probably it is much more than this. From the point of view of Merino sheep this rainfall seems to be too great as Merinos are stated to be best suited to a country where the annual rainfall does not exceed 20 inches. Cross bred Merino sheep might be tried but in my opinion black faced mountain sheep would be the most suitable breed for this region. The experience of sheep farmers on similar high plateaux say in Kenya Colony would be a valuable guide in this connection but before any sheep farming on a serious scale is undertaken on the Nyika Plateau experiments should be tried on the spot in order to determine the individual suitability of the various breeds to the local conditions.

Cattle would probably do well on the Nyika Plateau but it appears to be a sheep country par excellence. A few cattle were seen at Mlongolwe's village in the southern area and all appeared in good condition. The usual ticks common to Nyasaland were observed. Goats were found in the above named village and were in excellent condition. No sheep were met with on the Plateau.

The Nyika Plateau is undoubtedly a splendid tract of country well suited to European settlement though rather inaccessible at present and it seems a pity that it should lie practically useless to both European and natives as is the case at the present time.

From observations of the grass flora of the Nyika plateau, the Vipya downs and other High Veld areas in Nyasaland, I am of the opinion that there is very little difference in the species mostly present and their distribution on various soils.

AGRICULTURAL SURVEY. PART 7.

THE VIPYA HIGHLANDS AND DOWNS

BY E. W. DAVY, M.B.E.

THE VIPYA.—This term is applied indiscriminately to the elevated lands that lie on the eastern side of Momberas district and the western side of the West Nyasa district—a large area roughly lying from 4,500 feet upwards in elevation with a considerable diversity in soils, climate and vegetation. More strictly the term Vipya applies to areas of open grasslands of a relatively dwarf type. Owing to the configuration of the land and the direction of the prevailing winds, the greater portion of the true Vipya lies to the east of the watershed dividing the two districts—an area that is so exposed and windswept that trees do not exist except in a few hollows, whereas on the western side which is sheltered from the prevailing winds, the lands naturally consist of forest of some type, in spite of a lower rainfall, and such areas of grasslands as occur—now considerable—are not natural, but are the inevitable succession to the destruction of the forest by natives in recent times.

The actual grasslands are very undulating, and abundant clear running water occurs in every little valley, and as these valleys run in all directions in spite of the general slope of the mountains to the east, there is always some degree of shelter to be obtained from the winds which, whilst mainly eastern, vary during the year from due north to due south, via east. In the north the convolutions of the land are most pronounced, and the grassy areas are very steep, with narrow ridges, whilst as one travels south the tendency is more and more towards the development of gently undulating rolling downs on which cultivation by implements is feasible.

On the whole the grasslands of the true Vipya are very uniform in composition, there being only a minor amount of inferior tussock grass on the highest points, and the bulk of the area is occupied by grasses of a climax type, in which species of *Andropogoneae* predominate. The dominant species is undoubtedly *Themeda triandra* which is found in several varieties. This is an excellent pasture grass, and it makes a very good hay. Whilst not so deep rooted as some other species, it is most important in lessening soil erosion, as its dead leaves tend to break up into fibres which form a spongy mat over the surface of the soil. It is more sensitive to the effects of bush fire than many other species, and when this factor is long continued, it becomes invaded by other species of lesser agricultural value, and becomes gradually suppressed.

Among species which occur mixed with the dominant *Themeda* or which form almost pure stands at times, the following may be mentioned as having distinct agricultural value—when kept low in growth by grazing or cutting early. *Andropogon gayanus*, *A. schirensis*, *Hyparrhenia hirta*, *H. cymbaria*, *H. filipendula*, *Monocymbium ceresiiforme*, *Heteropogon contortus* and *Exothea abyssinica*. In the hollows near water, and fringing the small clumps of trees various tall and very coarse *Andropogoneae* occur. There is remarkable paucity of panicoid species of such genera as *Brachiaria*, *Digitaria*, *Paspalum*, *Urochloa*, *Echinochloa*, *Panicum*, *Pennisetum*, *Setaria*, etc., which goes to prove the long period during which the Vipya has existed as a climax grassland, the species of such absent genera being generally ruderal, i.e., growing in waste places during the transition from cultivated forest lands to permanent grasslands. There are but few species of *Eragrostis*, and *Chloris virgata* is far from common.

There is unquestionably an abundance of excellent grazing grasses on the Vipya, yet the area has a bad reputation among natives. How far this is due to moving thereto cattle from low levels, which thus fail on account of exposure to cold, and indicates a necessity for acclimatisation, or how much depends on the existence among the grasses of various poisonous plants, it is impossible to say. The area was surveyed in the autumn, when the maximum number of grasses were in an identifiable condition, whereas the majority of non-graminaceous plants are vernal, and in autumn are hidden by the rank growth of grass. There is need for a detailed ecological survey of the flowering plants other than grass during the spring, when they are in evidence, as many of them can be economically important in the wrong direction. It is possible that cattle have been taken on to the Vipya for the spring grazing, after the fires. Grass burning tends to develop the abundance and extent of non-graminaceous plants, since their development depends on their being able to make an early start in spring, before the grass gets tall enough to stop their growth by

shading them. This goes on year by year, but if grasses were unburnt, then other plants would gradually die out. Very many of the earliest species to come into growth are bulbous and tuberous plants of the *Asclepias*, *Iris*, *Lily* and *Amaryllis* family, many of which have decidedly poisonous properties, and in the absence or paucity of new grass growth, cattle may have grazed heavily on these "weeds" and got poisoned thereby.

The western Vipya as already stated is of an entirely different type, being primitive grassland, resulting from the destruction of forest for cultivation, and subsequently abandoning the land to natural agencies. The botanical composition of such areas is consequently most complex, and varies enormously according to soil type, to age, and to degree of mismanagement. With adequate protection such areas would gradually pass through various transitions to forest growth, and would not remain long in a climax grassland stage, as is the natural tendency on the eastern side of the watershed. The composition of the vegetation and the succession is most difficult to analyse. In general the grasses strikingly absent to the east are here plentiful. Annual species predominate, and perennials gradually get established. The weed flora is very much in evidence, and panicoid grasses such as *Panicum*, *Digitaria*, *Setaria*, *Tricholaena* and *Melinis* are abundant, as are species of *Eragrostis*, *Chloris*, etc. Few of the grasses tend to carry over the autumn and winter in a condition attractive to livestock.

In any eventual development of the Vipya by Europeans the logical method would be to farm both the eastern and western types simultaneously. The former would be developed into a pure grazing area and by good management—principally the control of fires—the value of the grazing would steadily improve. Cultivation would be restricted to suitable portions of the western area, a part of which could be developed into grazing lands and forest. The crops would be various cereals and pulses, perhaps with tobacco in places—all annual crops. There appears little possibility of successful development however until the more tropical portions of the West Nyasa district—subsequently described—are well developed. The latter area would then provide an excellent market for much of the produce of the Vipya area. There would of course be an eventual possibility of an export of hides, wool and other animal products from the Vipya, in addition to the production for local consumption of cereals, etc.

REPORT ON THE VIPYA PLATEAU WITH SPECIAL REFERENCE TO ITS SUITABILITY FOR CATTLE AND SHEEP RANCHING

BY Capt. J. M. CULHANE, M.R.C.V.S.

The Vipya (Chinyanja Zipsya) is the name given to a tract of country of more or less plateau formation situated partly in the Chintechi and partly in the Mzimba districts, the boundary between these districts being the watershed which runs through approximately the middle of the area. Its average height above sea level is approximately 5,500 to 6,000 feet.

On the east the Vipya is bounded by the mountainous region of the Chintechi district and on the west it slopes gradually to the Mzimba-Ekwendeni plateau. From north to south the Vipya would appear to be about fifty miles in length. Its width varies from about sixteen miles to the north of the Chintechi-Mzimba road to from two to three in the southern part below Loudon Mission.

The Vipya is hilly in the northern or Ekwendeni section and more or less flat in its central and southern areas. Its eastern outskirts are broken and on the west it descends in two terraces to the Mzimba plain. The Vipya is far more accessible than the Nyika especially on its western border. On its eastern side it is readily reached from both Nkata Bay and Chintechi.

As is the case with the Nyika plateau the water supply of the Vipya is abundant, numerous streams of excellent water running through all parts of it: a great contrast with the Mombera region to the west.

Compared with the Nyika plateau, however, the general aspect of the Vipya is disappointing. The country is more broken and there are no great stretches of undulating country such as one sees in the former region. The general appearance of the country is somewhat similar to that of the tableland between Dedza and Mlangeni, more especially the country in the neighbourhood of Mlanda Mission.

Timber is more abundant on the Vipya than in the case on the Nyika plateau and this is especially so in its western part which is largely covered with small trees. The other parts of the plateau show the usual scattered clumps of evergreen trees commonly found in such regions. The grass grows rather long in many places though there are large areas of shorter vegetation chiefly in the central part of the plateau.

The climate of the Vipya is cold and bracing and the rainfall heavy. The country is very exposed to cold winds from the east and south east and the nights are invariably cold. Frosts are common in the cold season and would appear to be somewhat severe at times as in several places vegetation was observed which had apparently been killed and withered from this cause. At this time of the year too most of the region is burned by the bush fires.

Although the Vipya would appear to be an ideal game country very little game seem to be found there especially on the higher ground. Personally only a couple of reedbuck were seen whilst on tour there. Numerous traces of carnivora were observed and it is said that these animals are by no means uncommon.

As also obtains on the Nyika plateau very few natives live on the Vipya, a fact due to its cold and somewhat inhospitable climate. From the point of view of both climate and density of native population therefore it would appear that these areas of the Mzimba and Chintechi districts are most suitable to be alienated for European settlement. The average altitude of the plateau being considerably less than that of the Nyika would of course render it less trying to people prone to cardiac affections.

There are but few cattle kept by the natives on the Vipya and these are to be found on the western part. The cattle inspected by me were found to be in poor condition but in this particular area the grazing was bad and the very cold weather did not assist in improving the appearance of these animals.

Generally speaking from the point of view of stock raising the Vipya seems better suited to cattle than to sheep. There is much ground covered with long grass and also a fair proportion of timber and the area under short grass although considerable is not sufficiently great to warrant sheep in preference to cattle ranching. I believe that sheep of the mountain breeds or cross bred merinos would do well on parts of the Vipya but on the whole I consider that the country like similar regions to the south, would be more profitably occupied by cattle. Cross bred cattle of the Afrikaner, Ayrshire, Polled Angus or Kerry strains would be the best animals to try in this region but individual suitability to the local conditions can only be determined by actual trial on the spot.

The Vipya has advantages over the Nyika plateau in its lower altitude and greater accessibility and would be a good cattle ranching country. It would appear to be rather too cold for such economic crops as tea, coffee or tobacco but wheat might succeed. As regards sheep farming it lacks the vast stretches of short grass found on the Nyika plateau and in this respect sustains no comparison with the latter region. Considering the situation as a whole it is considered that sheep farming attempted on a large scale on the Vipya would not pay, although there is no reason why a small stock industry organised on proper lines might not be fostered at some future date. If for example a great number of small holdings were established each might run a small flock and the wool and meat dealt with at central factories.

NOTE. The hill areas of Mwamlowe and Mwankhunikira being very broken country between 4,500 and 5,500 feet are partly a continuation of Vipya grassland at the higher elevations and of the broken mountainous country of northern West Nyasa. The precipitous wooded foothills fall abruptly to the Lake shore with a very narrow littoral on which the majority of the people in these sections of Mzimba exist.

The South Rukuru divides these sections from that of Chikulamayembe and here winds between steep cliffs and the drop to the Lake is sheer.

An interesting hill is Usamwala on the southern side of which is some good land near the village of Usawawa covered partly with evergreen rain forest. This area might with terracing be suitable for such perennial crops as tea.

AGRICULTURAL SURVEY. PART 8.

THE AHENGA HILLS AND VALES.

Reports by Mr. F. BARKER, and Mr. C. G. CHARLES, Agricultural Officers of
North Nyasa in 1931 and 1937 respectively.

THE UPPER HENGA VALLEY

by Mr. F. BARKER, C.D.A. (1931).

The above named area is situated in the south easterly portion of the North Nyasa district at a distance of some 85 miles south from Karonga and lies between the rivers Rumpi in the North, the Nehenicheni in the south and the Kambwia in the east.

As a result of my examination of this part of the district I am of the opinion that a main area offers promising coffee growing possibilities under the climatic conditions of Nyasaland whilst a more southerly and easterly area appears to be less attractive.

The main area is situated in what might be termed a drainage basin of a portion of the Nyika the proximity influence of which plateau mass must, to a very large extent, govern climatic conditions of country so closely adjacent to it.

Small pockets of suitable land exist here and there to the north and north west and to a lesser degree in the east, of the approximately demarcated area.

According to native information the rains commence in November-December and continue on into May with heavy mists in June and July. Actually two light showers fell when I was in the area (August) and when heavy dews were observed to occur overnight.

On studying the topographical features of the country it seems reasonable to assume that rain will often fall on the main area within the close shadow of the Nyika and not precipitate itself on the country east of the Kambwia stream nor to the south of the Checheche stream. The latter is approximately the northern limit of the Lower Henga Valley in which is situated Mburunje and where the rainfall is obviously lighter, and of shorter seasonal duration, as judged from general appearance of vegetation and type of agriculture. This assumption is supported by native information.

One is immediately struck by the verdancy of the country associated with this report and by the abundance of permanent water which flows through it. Comparisons with the Misuku which I examined in August-September of last year were naturally drawn. Whilst the area of lower Nyika slopes bear a general similarity to Misuku country there are certain outstandingly attractive differences which favour the former.

Tree life is more generously represented.

Soils generally have the appearance of being darker in colour, richer and less eroded.

Hill slopes, swells and hogbacks wherever cultivated carry good maize crops much more extensively than in the Misuku where finger-millet is more generally cultivated in such situations and it was also noted that beans planted after maize on hillslope gardens were in many instances still green. Bottom lands corresponding with Misuku viwanda alluvial bottom lands are on the whole larger.

On the lower Nyika hillslopes, and in the valley proper, grass was much more luxuriant in growth than in the area to which comparisons are being drawn and it was further noted how succulent it was for so late in the season.

Questioning of natives brought forth information that Nyika hillslope gardens are maintained over a considerable period of years under maize, beans and/or peas and sometimes wheat. This degree of lasting fertility did not appear to apply in the Misuku where gardens seem to lose fertility rapidly.

It will of course be understood that there are no cattle in this area and therefore the better conditions represented are due in part no doubt to the absence of close grazing which prevails throughout the cattle country of the Asukwa people.

The Mission holding represents the greatest block of unbroken country in the entire area.

North of Chidiwo the mountains rapidly close in upon the valley. East of the Kambwia stream the country is very broken and less attractive agriculturally and this in some measure is borne out by the tendency of natives residing there to cultivate gardens on the Nyika hillslope areas to the west. In fact it would be reasonably safe to estimate that quite 80 per cent. of the native agriculture of this part of the district is conducted well to the west and north-north-west of the Kambwia.

After leaving the Ncheni-cheni stream and dropping down southwards to Mburunje in the lower valley a sharp transitional stage occurs. The red soils give place to greyish types until after crossing the Checheche stream the change towards greyish loams, tending to sandiness in places, is almost complete.

The now widened and flattened out valley is situated between the Nkara Hills which skirt the western bank of the South Rukuru river up to its confluence with the Kambwia stream and the southern limits of the Nyika mass the near influence of which is removed from this upland plain.

The following altitude readings were observed.

Kaziwiziwi stream at road crossing	...	...	3,500'
Rumpi river	"	"	3,400'
Chidiwo	...	...	4,200'
Lura (Karamteta)	...	...	4,100'
Mburunje	...	...	3,250'

Dominant forest representations are found.

- | | | | |
|----|---|---|---|
| a. | <i>Afrormosia</i> sp.
<i>Parinarium</i> sp.
<i>Misongola</i> ('K)
<i>Nyengele</i> = <i>Diospyros mespiliformis</i>
<i>Mdima</i> = <i>Diospyros Royena</i> spp.
<i>Protea</i> sp. | } | Mzinga road crossing to Chidiwo |
| b. | <i>Parinarium</i> sp.
<i>Nyengele</i> ('K) <i>Mdima</i> ('Y) | } | Lower Nyika slopes—sparingly represented. |
| c. | <i>Uapaca</i> sp.
<i>Parinarium</i> sp.
<i>Brachystegia</i> sp.
<i>Misongola</i> ('K)
<i>Protea</i> sp. | } | Chidiwo in the north, bottom of lower slopes of the Nyika in the West—Nchenicheni stream in the south and eastward to the Lake. |
| d. | <i>Brachystegia</i>
<i>Mkukwi</i> ('Y) <i>Terminalia</i> | } | Nchenicheni stream to Checheche stream in which a gradual transition out of the red earths takes place (and the Nyika recedes westwards) as one drops down into |
| e. | <i>Afrormosia</i> sp.
<i>Acacia</i> sp.
<i>Bauhinia</i> sp.
<i>Msolo</i> ('Y)
<i>Msangu</i> ('Y)— <i>Acacia albida</i> | } | the Lower Henga Valley where conditions are entirely changed. |

An experiment block of coffee is recommended and greater favour to the hillslopes than to the valley may be shown because most natives would prefer to cultivate in their proximity and it would therefore be necessary, and advantageous to demonstrate the best methods of cultivation under conditions the counterpart of those represented on gardens such as they would choose to be representative of these features which includes viwanda (alluvial bottom) conditions. It was noted that a very progressive native, one Mwaraho Haraba, has very ably ridge-terraced a hillslope coffee garden.

In conclusion favourable impressions of the possibilities of the area. The greatest weakness of its restricted domain being the smallness of population.

THE UPPER HENGA VALLEY

by Mr. B. C. G. CHARLES. (1937)

The Upper Henga Valley extends approximately from the Livingstonia Mission at Kondowe to a mile or two south of the Nchena chena coffee plots, a distance of about sixteen miles. The area of land under cultivation, and in fallow, would be about forty-five square miles. The area may be subdivided as under:

- (a) The area of Kajoni and Thonda and the valleys of the Rumpi and the Kaziwiziwi.
- (b) The Mzinga valley, rising to the Chidiwo ridge at its southern end.
- (c) The Nkaramteta area, watered by the Lura, Nkaramteta, Nchena chena and Checheche streams.

CLIMATE: There is a marked wet and dry season per year, the former extending from the end of November to the beginning or middle of May. In the rainy season the rainfall is in the neighbourhood of 50"—60", while in the dry weather from 2½"—5" may fall. Examination of rainfall figures from the Nchena chena plots shows that the heaviest falls occur in the five months from December to April inclusive and that slight falls occur in May, June, July and even August.

Annual Fall in inches	...	...	...	1934-35	...	51.70"
				1935-36	...	48.73"
				1936-37	...	52.48"
				Average	...	50.98 inches

Temperatures appear never to rise very high but may fall almost to freezing point in the months of June and July. The following average maximums have been recorded to date at the Nchena chena plots:

1937 ...	January	...	...	73°F
	February	...	...	75°F
	March	...	...	76°F
	April	...	...	76°F
	May	...	...	73°F
	June	...	...	70°F
	July	...	...	68°F
	August	...	...	71°F

The only records for average minimums are as under:

1937 ...	June	...	...	53°F
	July	...	...	51°F
	August	...	...	52.5°F

Frost damage has not been noted this year, though it occurred elsewhere in the district.

Altitudes vary from approximately 4,000' to approximately 4,500'.

SOILS AND VEGETATION: Soils in general on the hill slopes are dark reddish in colour with a fairly heavy clay content, while in the valley bottoms it consists of black alluvium, rich in humus. So steep are some of the slopes under cultivation that natives have been known to fall from their gardens and injure themselves more or less severely. The local practice is to hoe the ridges up and down the slope instead of across it. At first sight this appear to be entirely contrary to all established agricultural practice and that the resulting soil erosion must be enormous. In actual fact, however, it would appear that storm water is carried away on the hard subsoil between the ridges and that, though considerable erosion does occur, it is not so serious as it would at first appear. Natives say that, if ridges are made along the contour, there is a likelihood that the water thereby held up may eventually burst and intensive gullyng may occur. This may or may not be so under efficient supervision, but it must be noted in their favour that natives have been cultivating these slopes for a considerable number of years. The soils in question are remarkably fertile and regularly carry two crops per season, one being nearly always a legume, for a number of years before a period under fallow ensues.

Hill slopes in general carry, or have carried, stands of almost pure Misuku (*Uapaca kirkiana*), as do the flatter lands in the Nkaramteta area. Considerable growths of bracken are met with in land formerly under cultivation. In the valley bottoms and along stream beds the following are noted: Nkorongo (*Grumilia kirkii*), Mombo (*Brachystegia* spp), Mwanga (*Afrormosia* spp), Katope (*Syzygium*), with occasional Mpapa (*Brachystegia* spp), Mlombwa (*Pterocarpus angolensis*) and Muntukutu (*Bauhinia thonningii*).

CROPS: In this outstandingly fertile area excellent crops of maize, finger millet (*Malesi, Eleusine coracana*), beans (*Phaseolus* spp), and wheat are grown. Beans provide two crops a season. A native coffee industry has been started in a small way and is capable of expansion in the numerous small pockets of suitable soil that exist. There are few, if any, large areas suitable for coffee and the native industry can never be anything but small. Tea is grown on a small scale and appears to thrive and there is a limited area of land which should grow good tobacco. Irrigation is possible in a number of places, especially in the valleys of the Lura, Khowe, Nchena chena and Checheche streams, and has been tried with success at the Nchena chena coffee plots.

English potatoes, and vegetables grow well and a small amount of bees' wax is produced in a sporadic manner.

DEVELOPMENT: Development of the native coffee industry might well go forward though it can never amount to very much on account of lack of people and large areas of suitable land. It should, however, prove a useful help in the district, especially as at present there are no marketing troubles.

The bean crop is probably the most useful for development and with a little encouragement, and a fair price to the grower, a considerable tonnage could be produced. Work might well be done with other beans, i.e. soya, lima, tepary, haricot, Madagascar butter, etc, so that should they prove suitable, and the purchaser see a profit, they could be distributed and encouraged. Tung oil, should it turn out to grow well, might suit the Upper Henga valley, where a more or less settled type of agriculture prevails and there appears to be a certain amount of permanency.

Finger millet is to be discouraged at all costs on account of its wasteful methods of cultivation and destruction of timber, with consequent acceleration of soil erosion and diminution of supplies of permanent water. Work might well be done to popularise other varieties of millets in its stead: Japanese or Foxtail millet (*Koti-Koti*) appears to do well and is already in fair demand among natives for the excellent beer that can be made from it.

It must be noted that the Overtoun Institution, Livingstonia, purchase the bulk of its food requirements in the Upper Henga Valley, but that potential production far exceeds their requirements.

Good wheat is grown and a fair tonnage could be grown should a demand arise for it. With imported wheat at its present high figure something might be done to encourage wholemeal flour in the country.

THE LOWER HENGA VALLEY.

The Lower Henga Valley extends from a mile or two north-east of Mburunje to the Njakwa Gorge and the confluence of the Rukuru and Kasitu rivers, a distance of approximately seventeen miles. The width of the valley varies from two to three miles, and the slopes are generally gentle, rising steeply to the foothills of the Nyika on the north and the Vipya on the south.

CLIMATE: The climate is more extreme than that of the Upper Henga Valley, though the altitude is less, being about 3,500' in general. No figures for rainfall or temperature are available as yet, but in May, June and July considerable cold is experienced at nights, and in the latter months of the year it can be extremely hot by day. Considerable frost damage was done this year to bananas and cassava, more especially in the dambos, the native opinion has it that this is unusual. Rainfall probably varies between 40"—50", with 2½"—5" in the dry season. This year, apparently, the rains were heavy at the beginning of the season and then ceased very early with consequent damage to the maize crop. High winds are usual in the middle and latter months of the year.

SOILS AND VEGETATION: The deep red soils of the Upper Henga Valley peter out near Mburunje, as does the association of Misuku (*Uapaca* spp). The soils in the Lower Henga Valley being greyish in colour and sandy in texture, though with areas of reddish sandy katondo at the base of the fringing foothills. Considerable stands of Acacias are met with in association with the following:—Ntanga-tanga (*Albizia* spp), Mtawo (*Cassia* spp), *Ficus* spp, Muntukutu, and Mpolya (He). Some stream beds carry Mwanga (*Afrormosia* spp), and Mnyanyata (*Diplorrhynchus mossambicensis*). The fertile lower slopes peter out as they rise to the foothills in Mombo (*Brachystegia* spp) scrub, more or less useless for anything but gardens of finger millet. Big Nsangu (*Acacia albida*) are met with in some stream beds.

CROPS: Excellent maize land, carrying heavy crops in good normal years, also good crops of beans and groundnuts. Rice has been tried in the dambos with success but no development has taken place on account of the lack of demand and its unpopularity as a food in the locality. It should be possible to grow good tobacco, and cotton was grown at the Njakwa some years ago by an Indian with success. Bananas are fair but papaya grow well.

DEVELOPMENT: The Lower Henga Valley is capable of considerable development if the native can be offered sufficient inducement to cause him to plant up bigger acreages. A large tonnage of maize could be produced, as well as beans and groundnuts. Cotton growing, generally speaking, is problematical and experiment would first be needed in order to establish the industry on sound lines. Rice could be grown in fair quantities though finger millet is banned for the reasons given above. The streams Luzi and Lufira provide opportunity for irrigation, which might well prove useful on these gentle slopes.

BEESWAX. A small amount of beeswax is bought at Lura in the Upper Henga Valley, but it is generally of poor quality and has to be refined before export. In a number of remote areas natives have reported that a considerable amount of honey is usually thrown away as there is no demand for it. It is one of the few products of these remote areas that could stand the very heavy transport charges at present home prices. A local firm has a string of stores throughout this area and serves them by motor lorry which usually returns down country empty. Their agent has been approached and considers that he could pay a very fair price to the native by taking advantage of the cheap transport afforded by his returning empty lorries; he has shown considerable keenness and is looking into the matter of home prices, etc.

It is considered that relatively large quantities of beeswax might be produced in these remote northern areas. The lower slopes of the Nyika and the Vipya afford admirable terrain and there are a large number of small villages scattered in relatively inaccessible place, whence the carriage of a high-priced product down to the stores or markets would be but little hardship.

A start has been made at Nchena-chena with the a small bee-farm using native-type bark hives with the addition of queen excluders, the object being to demonstrate to natives the possibilities and the methods of rendering down the beeswax into a high-class product commanding a higher price. Also of endeavouring to elucidate the numerous small problems that are bound to arise in connection with the processing of the wax and to train native instructors for district work and demonstration.



17

Untidy native cultivation with sheet erosion in Kasungu.



18

Very severe gully erosion in Mzimba where a shallow dambo existed but a few years before. This is due entirely to large destruction of woodland of gardens.



19

Warning. An old ridge terrace on soils depleted of organic matter and of low absorption. A serious break owing to water being held up leading to much loss of top soil.

AGRICULTURAL SURVEY. PART 9.

THE COTTON BELT OF SOUTHERN KOTA KOTA.

Report by Mr. R.W. KETTLEWELL, B.Sc., A.I.C.T.A.

It is necessary to state at the outset of this report that the area dealt with accurately and in detail will be the entire lake shore strip and the thickly populated foothill area in the neighbourhood of Nchisi mountain only. The upper levels of Native Authority Jere's section and the whole of Kalumo's and Nthondo's have not come within the scope of my work, and are on the fringe of the main tobacco area.

BRIEF GENERAL DESCRIPTION.

One of the chief features of the remainder of the district is a wide belt of *Brachystegia* woodland about 10 miles in width at the southern boundary and broadening as it follows the lower shelf of the foothills northwards. At a distance of about 10 miles from the Chirua this belt has so widened as to have reached the lake shore to the east at the Nkumbaleza river, and the main escarpment hills to the west, there to unite with the *Brachystegia* forest of the Nchisi ridge. Agriculturally this belt is highly infertile, and the greater part of it consists of a granitoid soil in varying degrees of decomposition. It divides the more fertile and populated part of south Kota Kota into two halves—the flat wedge-shaped lake plain, and the undulating foothills beneath the main escarpment. North of the Nkumbaleza river the whole lake plain and lower foothills consist mainly of coarse quartz or granite sand, interspersed with finer and more fertile patches, and carrying small trees and thin grass. Maize will not thrive and cassava flourishes in its place as the staple food crop. The whole district is threaded by six or seven large rivers, all of which are perennial and which drain the hill waters into the lake.

For the sake of easier description the district may be divided into its administrative sections, and the ecology and agriculture of each discussed separately.

NATIVE AUTHORITY MWADZAMA.

The total taxable population of this section approximates to 2,500, nearly all of whom are Achewa. It is sharply divided into two regions by the *Brachystegia* belt already mentioned: the westerly, or lake portion, carries nearly two thirds of the total population of the section, and includes the Native Authority's village; whilst of the remainder, half live just inside and half just outside the western boundary of the foothill *Brachystegia*. The northern half of the section, from the Nkumbaleza to Chia marsh, is all nsanga country little above lake level and of low fertility and sparse population. It will readily be seen therefore that only a relatively small proportion of this large section consists of the fertile alluvial and brown soils, which constitute such an important part of the lake shore districts and Bwanje valley further south. These soils are, I believe, almost the first of their type to be encountered to any extent south of Karonga on the lake shore, and are limited to the neighbourhood of the Chirua and Mkula rivers six miles apart. Even within this area a narrow tongue of infertile soil intrudes lakewards between the two rivers, and is a source of disappointment to the population which has overflowed on to it from the alluvial land. Needless to say, so fertile a neighbourhood carries a high population; and there is little room for expansion except on the narrow alluvial strips on either side of the dry streams Lingodzi and Chipwidzi. Four wells are to be dug to encourage the settlement and cultivation of this hitherto undeveloped area.

VEGETATION.

The trees which characterise the fertile soils are msangu, mbvunguti and mtete, all of which attain a good size. The former species is never cut in the course of garden clearing, since the light shade which it provides before coming into leaf in April is often a great blessing to maize in dry years. Msangu are, however, cut under permit for dug-out canoes. The common grasses on these brown fertile soils are tsipe, ntsekera, luba and msonthe, all common to this soil type in other districts further south. Another good soil indicator of common occurrence is the shrub chanzi.

MAIZE.

The rains begin in early December and continue until April, during which time 40" or more may be about the average fall. This relatively high figure is doubtless influenced by Nchisi mountain, which lies some 20 miles inland from the lake and 4,000 feet above it. At times some flooding takes place near the outlets of the Chirwa and Mkula; but it is not often that appreciable damage is done to the numerous crops of maize which are produced every year in the vicinity of these two rivers. This staple crop is planted early in December, mostly on the semi-dimba soils bordering the rivers, and which are naturally of medium stable fertility. The average size of garden recently sown was two acres and yet a surplus of maize is the rule, and quantities in January to which no fewer than five neighbouring sections looked during the food shortage of early 1926. A further 70 tons of maize were sold after the ensuing harvest.

COTTON.

Cotton was planted for the first time on a big scale at the end of 1924, since when the number of growers has steadily increased to what must now be over 800 of the taxable population of the normal size along some 100 miles of river. Yields have been good, but there is a definite tendency for the unplanted land to run to too much rank and growth when it is sown on the rich soils of high water-course environments. Early January planting is therefore advocated for these soils, but even so, crops at these late times, such as 1926, the physiological shedding of bolls and flowers is diminished in life. Some cotton has been planted on the small upland soils of normal fertility covered by low forest, notably its margins (which are characterised by Myrsine trees) with hope of success can be expected after the second year at least, where possible, the disappointed growers would be well advised to turn to rice as a cash crop. The latter crop is not little grown in the southern area of Kota Kota owing to the general preference for cotton.

ROTATION OF CROPS.

The rotation of crops is at present particularly unimportant and is, of course, less of a necessity here than is frequently the case elsewhere. Nevertheless, on the lighter non-alluvial soils would greatly benefit from a rotation including maize, cotton and ground pea; and the latter crop should be introduced within the next few years. It is not, as yet, a popular food, but might at least form a useful standby in lean years, in addition to its normal function. The only restorative crop at present grown is beans, but these are mainly confined to the already fertile dimbas on the Chirwa and Mkula rivers, where they are planted after an early maize harvest in April.

DIET.

Almost the sole source of food protein is provided by fish, of which large quantities are eaten whenever possible. Fishing is also a profitable industry in the Nkumbaleza area, thereby providing a useful livelihood in a locality unsuited to agriculture. Sweet potatoes are grown to a small extent, but maize and fish constitute by far the greater proportion of the normal diet.

INFERTILE NORTHERN AREA.

North of the Nkumbaleza, as has been mentioned already, the broad belt of Bruchystegia widens to the eastward and pervades the whole of the rest of the lower level of Mvadzama's section, transforming it into a dry, infertile country which is consequently sparsely populated. Maize begins to give place to cassava, cotton is little grown, and the chief centre of agricultural activity is the Likowa river, where rice has been grown for years.

MWADZAMA'S FOOTHILL AREA.

Some eight miles inland from Mvadzama's lake area is situated the balance of about 35 villages at an average altitude of a little over 2,000 feet. Here the general level of fertility is lower, the proportion of occupied nsanga is higher, and soil erosion is an ever-present factor. The principal streams are the Liloliza and Kasangadzi, which run parallel through this area after leaving Native Authority Kasakula's section. The water supply of the former river is largely protected by the Nchisi forest reserve on its west bank; but the latter must assuredly be suffering from being flanked throughout its useful length by cultivated slopes.

SOIL AND VEGETATION.

The soil to the west of the nsanga and between the above two rivers is a fertile katondo or reddish pelon, but frequently of no great depth and often rather "vannic" in appearance. The predominant tree is nitete, and nitete the commonest grass. Fortunately the soil is not very easily eroded so it would no longer be carrying its present population but the slope and

shallow soil are bound to lead to trouble, although in this respect this portion of Mwadzama's has brighter prospects than the more broken country of Kasakula and Jere nearby.

CROPS AND SOIL CONSERVATION.

Maize is again the staple food and gardens usually last for 5 or 6 years before being rested for a similar period. Maize cultivation follows the usual practice of small separated mounds carrying from three to five maize plants each; and the inability of these to hold up any quantity of surface water on a slope is abundantly clear whenever it rains. The loss of surface soil and of water, which should rightly be stored underground for drier times, is such as to demand considerable and continued attention. Cotton growing has developed to provide the usual source of tax, but the extra acreage of land which it requires makes soil conservation a matter of still more urgent importance. Fortunately the local natives take readily to the planting of cotton in small ridges roughly following the contour; but their natural conservatism with food crops hinders the change to this method of planting maize. There is great need for continued propaganda and instruction in this direction.

The remainder of Mwadzama's hill villages are either in or on the border of the Brachystegia. Some of them were forced to take to this less fertile land when they were evicted from the lower levels of Nchisi forest reserve (a fertile loam carrying mtete trees, and similar to that just described).

The characteristic trees of the border-line nsanga are mwanga, mombo and msambamfumu, changing to tsamba, kamponi and mombo as the true nsanga is reached. There is a corresponding change of soil, accompanied by a decline in fertility, from the reddish katondo which will carry maize for three to four years to the typical sand on which maize is grown for two years only. This latter soil is apparently unsuited to cotton on account of a chemically obstructive pan not far below the surface and one of whose characteristics is the presence of iron concretions. The border-line red katondo grows quite good cotton for three years, but rotation is clearly an essential which must be developed to permit permanent agriculture.

DIET.

The diet of this locality must be decidedly deficient in protein since little is grown in the way of beans or groundnuts, and the natives seem chiefly to rely on bought fish.

NATIVE AUTHORITIES KASAKULA AND JELE.

SITUATION AND TOPOGRAPHY.

These two sections, which adjoin Mwadzama's to the west, have many features in common. They slope from a height of about 4,500 feet on the Nchisi escarpment down to nearly 2,000 feet and into the main belt of nsanga. Both sections have scarcely a level garden in them and the so-called "chipeta", or long grass country is very thickly populated and fertile. The rainfall of the whole of this foothill district must be over 40" annually, and it is well watered by numerous small streams which mostly flow either into the Lifuliza and Kasangadzi in Kasakula's; or the Mbetwe, Mkula and Chirua in Jere's. The bulk of Kasakula's villages, which number about 50, lie on the watershed between the two first-named rivers.

SOIL CONSERVATION AND CROPS.

The soil and vegetation up to about 3,500 feet closely resemble those of Mwadzama's more fertile hill part, which has already been described in detail. The observations on soil erosion apply here with even greater force on account of the higher population and more broken nature of the country. In two out of the past three years maize has been short in these two sections largely, it is surmised, on account of the loss of surface soil and the absence of an adequate reserve of subsoil water for dry periods. A marked fondness for beer often further aggravates the shortage. Cotton growing has been extended into the lower part of Kasakula's, where it has done quite well nearly up to the 3,000 foot contour in the chipata country, provided that it is planted with the first rains. Including Mwadzama's foothill area there are nearly 1,000 cotton growers above the lake plain in Kota Kota this year; but the need for a local economic crop creates somewhat of a problem on account of the greater strain which it imposes on the soil. It is clear that an economic crop should only be encouraged and developed in conjunction with soil conservation and rotation extended both to cotton and maize conjointly throughout the whole area. The local inhabitants are not more than average idle agriculturally and are anxious to cultivate cotton where possible. Supervision is, therefore, to be extended into the suitable levels of Native Authority Jere's section this coming season; and, should the result prove successful on an adequate scale, the need for a cotton market for the foothill area should be

reconsidered. The most suitable site would appear to be Tanga village, situated centrally for the whole foothill cotton country of Mwadzema, Kasakula, and Jere, and some 14 miles from Benga on a new district road.

Above the 3,000 foot contour, which also approximate to the western fly limit, there is no cotton, and money is usually obtained by scattered tobacco growing, mat and basket making. Very few of the adult male inhabitants have not been to Rhodesia at one time or another; and a large proportion are still engaged in work outside the district. The presence of cattle and the still more broken nature of this higher country makes the wide cultivation of an economic crop a policy to be avoided at present. It is alarming to consider that some 25 villages have been forced to forsake the upper levels of Jere's hills during the past 20 or 30 years. A protective rather than developmental policy should, I think, be pursued in this area, and one would imagine that some attempt at reafforestation with indigenous timber would be worth while and the best immediate assistance which could be rendered to the locality. This area is, of course, easily accessible by road throughout the year.

AGRICULTURAL SURVEY. PART 10.

THE LOWLANDS OF NORTHERN KOTA KOTA.

Report by Mr. R. W. KETTLEWELL, B.Sc., A.I.C.T.A.

NATIVE AUTHORITIES MSUSA AND KANYENDA.

SOIL AND VEGETATION.

These two lake shore sections, of which the latter extends northwards to the Chinteché border (Dwombazi river), have also many points in common. Both are markedly lacking in good agricultural land and the prevalent soils are quartz or granite sands, relieved by small patches of river alluvium and occasional adjacent mixtures of the two, which provide a light but fairly fertile medium. Throughout this stretch of 70 miles of lake shore the most common trees belong to the *Brachystegia* group, which again occupies wide belts of country extending inland to the hills. Between these belts, and particularly on the more fertile sands, small *napini* and *mwanga* predominate, and *tsewe* grass gives place to *nyumbu*, which is commonest accompaniment to *nsanga* in that area. North of Kanyenda's village *msuku* trees begin to occur in scattered groups in the *Brachystegia*; and this species is nowhere else to be found on the lake shore as far south as the Bwanje valley.

RAINFALL.

The rainfall at Kota Kota itself averages about 52 inches annually; but local natives are of the opinion that this decreases somewhat to the north until the influence of the Chinteché hills is felt near the Dwombazi river. Flooding is often bad in the rains, but the retention of moisture is poor and the country quickly assumes a very dry aspect after the rains have eased off in April or early May.

The prominent alluvial patches, which incidentally do not compare in extent with those bordering the Mkula and Chirua, are on the Bua, Liwalazi and Dwangwa rivers. Of these, the former is sometimes subject to serious flooding and is said to remain uncultivated for that reason; but the presence of abundant elephant and buffalo may also have something to do with it. Of the alluvial margins of the latter two, the Liwalazi is the more extensive and fertile, and in great demand with the five villages grouped around it.

CASSAVA.

In spite of the fertility of these river margins they are planted with cassava in preference to maize, as is the case with all the less fertile remainder of Kanyenda's and Msusa's sections, and the crop does well universally. It is most commonly planted during the last three months of the rains, after the previous year's crop has been dug up to make way for it. Provided the cuttings are thrust into soft and newly-dug mounds, no difficulty is experienced in "striking", even on the most sandy soils or shortly after the rains are over. Roots are about the size of a man's wrist, and ready for digging, during the rains following planting; but occasionally the roots are allowed to remain in the ground a second season. The bitter varieties, which constitute the bulk of the crop, are generally retted in shallow pools for about three days before being stripped of the outer skin and dried for pounding into flour. A failure of the cassava crop is practically unknown and the only troubles from which it suffers are the mild leaf-curling virus and pigs etc.; and the gardens of the Atonga north of Native Authority Kanyenda's are frequently fenced to provide protection from the latter. The life of the gardens varies from an indefinite period on the alluvium and more fertile sand to two or three years on the worst type of sloping *nsanga* soil.

ECONOMIC CROPS.

Needless to say a market for cassava would be of the greatest benefit to the whole of this 70 miles strip of Kota Kota, and transport would provide no difficulty at all.

RICE.

At present, apart from a rather limited fishing industry, rice growing is the only local source from which money and tax can be derived. The annual rise of the lake causes the temporary

inundation of multitudinous dambos of varying size, which lie along the streams and just behind the foreshore of the lake. The recent encroachment of the lake has, of course drowned a great many old-established rice gardens; and in many places no new ones have been formed to take their place. In still further instances the people are naturally doubtful of the probable extent of new flooding, which makes them uncertain of the suitability of new land for rice and, since water supply is of greater importance to rice than soil fertility, disappointment and poor yields are a not uncommon result. (A fuller report on local rice has been made already and reference may be made to it for further detail and suggestion for improvement).

CASHEW NUTS.

A very minor crop, but one of which some use might be made, is the cashew nut of which there are some 500 mature trees in Kota Kota village itself. The fruiting season is November and December, and it is possible that some of the local trading firms in Blantyre and Zomba might buy them.

DIET.

The diet of this lake shore area is restricted to cassava and fish with the usual small additions of cassava and pumpkin leaves and occasional sweet potatoes. The addition of groundnuts to the diet would doubtless be useful, and it is to be hoped that their cultivation may later increase where possible if the attempt to develop them on the more fertile sands near Kota Kota village is successful.

SUMMARY.

ECONOMIC CROPS.

It will readily be seen that Kota Kota district is not blessed with unlimited facilities for producing cash crops. The lake shore area is the more fortunately placed in that cotton can be grown to the south and rice can be developed to the north, and both crops are easily and cheaply transported by lake. Further inland the southern foothills are capable of reasonable cotton development with care and guidance in the maintenance of fertility; but above the 3,000 foot contour the soil, its management and the transport of crops all combine to make a problem for which there appears at present no immediately productive solution while tobacco restriction remains.

SOIL CONSERVATION.

Like everywhere else, however, the production of economic crops should by no means be regarded as the be all and end all for the district. The population, which is already high in the southern half of the district, must be fast increasing; and no time should be lost in endeavouring to safe-guard for permanent use the areas which are already under cultivation. The policies which suggest themselves for the maintenance of fertility are fortunately simple, but require considerable drive and supervision in their execution. Briefly, the flat cotton area needs an established rotation; and for this purpose the introduction and multiplication of pigeon pea would seem to offer the greatest possibilities in the absence of an economic leguminous and restorative crop. The same applies to the foothill cotton area; but superimposed is the more urgent need for checking erosion, which could in some measure be achieved by the planting of all crops in small contour ridges instead of the present scattered mounds. Some success could be obtained on a wide scale in this way without the need for highly-skilled supervision.

DIET.

From the dietetic point of view the wider use of groundnuts would be of value and, inter-planted with maize, this crop would also provide a ground-cover to check soil wash. Everything should be done to spread its cultivation from the initial area in which the crop is to be tried this year. Possibly also an effort to stimulate wider interest in citrus growing would benefit general health, and seed for this purpose could doubtless be obtained from Chinthembwe Mission.

AGRICULTURAL SURVEY. PART 11.

THE EASTERN VIPYA, LIMPASA AND KONGA AREAS.

Reports by Mr. E. W. DAVY, M.B.E. and Mr. J. W. PRYOR.

The area is sometimes referred to as the Tropical area of West Nyasa being applied to the whole of the district between the Lake and the 4,000 feet level, although owing to physical configuration of the land the central half of the area is of greatest economic interest to Europeans, more especially in view of the fact that some sixty per cent. of the native population is at present in occupation of lands of any value along or within a few miles of the Lake shore. In the northern quarter the land is very mountainous right down to the Lake shore, and the native population, apart from the asset of fish from the Lake, has a rather precarious existence, dependent on the cultivation of excessively steep slopes—often at a great distance—which suffer from rapid erosion owing to ignorance or laziness as far as provision of contour drains is concerned. In the southern quarter there is a considerable area of moderate quality flat lands, interspersed with numerous rivers and swamps, backed by steep stony slopes of no agricultural value. In this area a larger populace can subsist upon the products of the Lake, supplemented by moderate crops of millet and cassava, and generally good crops of rice, but both ends of the district are practically useless from the European planter's point of view.

The central portion of the district compares favourably with the more tropical portion of the Mlanje district in many respects, the rainfall being equal to that of the centre of the tea belt, with an equally favourable distribution, whilst temperatures are probably slightly higher for similar elevations. The configuration of the land is generally much less flat than of the Mlanje tea area, especially above the 2,500 feet level, and as the majority of the natives have settled on the lower levels, as in other portions of the district, it is probably advisable to foster a continuance of this practice, gradually encouraging the minority to settle there also, as and when there is a demand for lands for European settlement in the district. From 2,500 to 4,000 feet the soils are generally deep and of medium texture. Owing to general steepness they are well drained, and there is an abundance of clear running water in practically every valley, large and small. Cultivation by implements is almost impossible, and the lands are emphatically suitable for the cultivation of perennial crops only. To prevent erosion, contour drains will be necessary everywhere, and on some of the steeper fertile slopes, terracing would be advisable as well. To take one crop alone—tea—it will be far more expensive to establish a plantation in West Nyasa than it has been in the past in the Mlanje and Cholo districts, owing to the more expensive methods of cultivation that will be involved. As against this, there should be a higher yield per acre, owing to the freer soils, and the longer growing and plucking season, whilst the diverse elevations at which cultivation of the crop will be possible, should lead to the production of teas of higher quality. There is everywhere abundant water for driving machinery, and consequently the forest resources will only be drawn upon to provide fuel for firing the tea after fermentation.

The land is generally well timbered up to 4,000 feet or more, and *Landolphia* rubber vines are plentiful in the lower portions. The "wild ginger" *Ammomum* spp.—is rather less common than in the Mlanje tea belt, owing to the better drained and less heavily shaded soils. An interesting wild plant that occurs plentifully in one portion of the area is the West African oil palm—extremely rare in the eastern half of Africa. Judging by native gardens in existence or abandoned, the weeds including grasses are rather less noxious than those commonly encountered in Mlanje, the dwarfer creeping types being more plentiful than the tall tufted species. This distinction is helpful in results, as soil erosion will be less severe under the creeping growth. The soils would in all probability grow coffee, but the rainy season is distinctly later in commencement than in the Shire Highlands—also continuing to a much later date. As coffee appears to depend largely on good rains in October and November, when the trees persist in flowering, the possibilities of a crop being produced in West Nyasa will be small—unless the trees abandon the strict adhesion to the calendar which they insist on in the southern part of the Protectorate.

NOTES ON LOWLAND AREAS OF WEST NYASA

BY MR. J. W. PRYOR who also forwarded a soil and population map of the area.

In the southerly section of N. A. Malenga there are 12,000 people which with the exception of five villages are crowded along the Lake Shore. The population density of the section is 40 to the square mile but if only the cultivable land is taken, the density becomes nearly 200 to the square mile. Prospects of economic progress are poor but a brief sketch of this and other sections which have an equal or greater population density on cultivable land can be given here. The soil at Malenga itself is a sandy loam type of medium fertility but west of Malenga, as far as the foot-hill regions, the soils are coarse sandy loam and sandy clay merging into a light brown sandy soil of poor fertility four miles from the Lake Shore. The usual narrow alluvial belt of good fertility is found along the shore and the crops upon which these Atonga people mostly subsist are cassava and pigeon pea. From Malenga to Malengasanga the coarse sandy soils are exceptionally fertile.

From Malengasanga to Zilekoma in the narrow alluvial belt about three miles wide there is a rapid change to fertile light grey loam and this belt narrows at times to one mile with short grass steppe further inland on poor grey soil.

Vegetation is as follows:

Sandy areas :	ntangatanga	...	mifindimbi
	mlombwa	...	mkalati
	napini	...	msopa
	mwanga	...	mwenya
Foot hill areas:	mlombwa	...	msekese
	chitowe	...	katope
	mkute	...	msuku (small)

From Zilekoma to the Kota Kota border only a very narrow strip of fertile soil is found, being again at Chiwembelwe on the Lake Shore barely a mile wide with heavy grey soil. To the west of this area, light grey and brown soils of poor calibre cover large areas although pockets of good soil do exist and a small village is often found precariously existing on such small areas.

Chiomba on the Lifupa in the foot-hills is dependent on a narrow strip of good grey sandy loam along the river banks the belt of two miles between here and the Lake being very poor soil. The people subsist on fields of cassava with very small areas of interplanted nandolo, maize and mapira and late planted beans and finger-millet. Similar riverine fertile stretches as at Chiomba exist along the Mazembe, sometimes reaching three miles wide but infertile areas are interspersed everywhere.

Again along the Luwaya river in N. A. Kabunduli a mile-wide strip of heavily timbered land denoting fair fertility verges on a large dambo where the village of Kamanganlulu is situated. From here rise hills of very steep slopes with hard red sandy clays (heavy katondo). These hills again drop to the Chikuyu river to the east and other steep hills separate this from the Kakewa, and no habitations exist in this desolation. The valley of Kakewa between the steep slopes and about 1,600 yards wide is quite fertile with good sandy loams, cassava being again the main crop. More maize, sugar cane and sesame are also grown.

The high hills facing the Lake in N. A. Gulu are well timbered with thick undergrowth on good red soils and water supplies are good. The vegetation is similar to that of the Mlanje tea belt comprising

mlombwa	mwenya
mwabvi	mlembo
kamponi	msenjere
msuku	mkulukulu
mpindimbi	mulewezi
muwawa	mpapa
mkute	tulipuli

In the range of hills Kaungu to Nkokwe there is some very fertile red soil, well watered with hundreds of small streams, with heavy timber and dense undergrowth. Such land with careful terracing would be suitable for perennial crops.

It may be remarked that isolated citrus trees and pineapple plants of good growth are found in nearly every village.

From N. A. Kabanduli to Samuel on the banks of the Luwaya small areas of good red soil support small villages between steep slopes with poor sandy loams. Everywhere again the broken country is well watered and the Luwaya becomes often a swift torrent in the narrow valleys. Steep hillside gardens with a few makandi strips are found and groundnuts, potatoes and sesame relieve the prevalent cassava fields.

The same tale of steep hill sides and narrow valleys must now be continued from Samuel across the Kajirilwe to Salima on the east side of the Kavosi river, six miles above the junction with the Luwaya and again very small villages are found along the swift flowing Kajirilwe. The river flows from the Vipya country passing the large village of Chamaoya.

More level country is found near the Kavosi river but depredations of monkeys and baboons preclude much cultivation and the area is becoming depopulated, two villages only being left. There is much good katondo soil with large timber and good undergrowth and this is the most promising area for development by plantation industries.

Trees are :	mpindimbi	
	mkute	mlombwa
	mwanga	mwanya
	tsamba	mpapa
	muuwa	msuku
	mulewezi	mombo
	katoli	nkuyu
	mtusa	sanya

The path from Salimu across the Kawaluzi river to Kasonka in N. A. Mkumbira again leaves good soil behind and passes over steep hill country, passing Chombe where well timbered land with light brown sandy loams of poor fertility interspersed with fertile patches covers several miles. A small village to the south-east exists on fertile patches amongst gravelly poor soils with poorer timber. From there more level land is drained by dambos between light sandy soil on the swells, until the slow flowing Liwenya, a small tributary of the Limpasa is met with.

Another series of dambos with poor soil brings one to the villages of Kasonga and Chiwavi. The soil here between the Limpasa-Luwaya junction is grey and very sandy. The usual crops are grown at Kasonga except that cereals and pigeon pea are unpopular on account of depredations of monkeys.

An isolated example of a good area outside the alluvium is at Mambo in N. A. Gulu, where a village of 80 huts cultivates good katondo soil on the swells above dambo soil running down to the Luwaya.

From Kaleya to Simon's village in N. A. Mankambira's country, thick forest is found on broken country with no villages for some miles until the villages of Damba, 80 huts and Chipeka, 59 huts, Thuli, 100 huts are cultivating some good land. The hills of Kaliskirka and Kapalakanji stand out from the four mile strip of Lake littoral to the east. Other villages are Petela, 150 huts near the Katawa river, Wanderan 10 huts before crossing Chipakasi river on which is Chizuma village, 70 huts, and the Kamwani river near which is Bungulu hill and Simon's village. These villages are divided by good forest land on fertile red loams, some steep land being suitable with terracing for cultivation.

Reports of tsetse fly in most of these areas were forthcoming. It is doubtful however if any true tsetse fly exist as natives may confuse them with other biting flies. 2000 cattle exist in these areas, mostly on the Lake Shore.

From Simon to Nkata Bay is a thickly populated area of Wateza, Jere, Chibaka, Chilelowana, Singu, Talika, Malenga, Kasweswe, Kolozera, Jope, mostly in N. A. Mkumbira although the country is still broken and much timber has been destroyed. Abnormal soil erosion on the steep hill gardens is very bad.

Other outstanding examples of abnormal soil erosion occur near the Lundazi Mission.

From the Vizara rubber estate of the African Lakes Corporation to the rivers of Wabanga and Dimbi similar country is passed until Chipapa village is reached. There are dambo soils of the Lilezi and Wambazi, some of which dry up completely. Others again in this low-lying country remain water-logged during the rainy season especially near the Limpasa.

Near the Liwasi which is a swift running river with steep banks is much poor orchard country and open woodland with poor grass. The western valley of the Limpasa from Goneka northwards contains some good red soil. Marshland covers all the area eastwards from the Limpasa to the Kandoli hills.

Little more need be said about the broken areas in N. A. Mkumbira which stretch for miles to the west and north of the Limpasa and Mwambazi. Villages seem to be continually moving, judging by old sites.

In N. A. Mbwana's section also the country is characterized by narrow strips of good alluvium on the Lake Shore and much broken country between these and the Vipya country which comprises over half this section.

Only four villages exist in the latter country. Naturally there are pockets of soil of good fertility and varying size in the hill country, the largest areas being found near the valleys of the Konga (Kanyuni Kamtoa).

The great obstacle to economic progress of the people of West Nyasa, perhaps more so than the poor nature of their country is their rooted objection to doing hard manual labour in the fields for any length of time. To think that any large numbers of these people will ever make small-holders who will work for many hours during the day at field tasks is merely a figment of the imagination.

There is plenty of money in the West Nyasa lowlands and the people are generally as well dressed as any in Nyasaland.

The money is derived from the large number of remittances from Atonga men who are working in Southern Rhodesia and South Africa where they are greatly valued as workmen clever and skilled at numerous crafts.

AGRICULTURAL SURVEY. PART 12.

THE VUA-NGARA LITTORAL WITH THE DEEP BAY AND HARA AREAS

BY A. J. W. HORNBY.

NOTE. The tours undertaken by the writer in 1926 and 1927 in northern Nyasaland were primarily undertaken to study the possibility of the cultivation of various types of tobacco with a view to such crops taking their place in the agriculture of European planters and of native growers. During the last tour he was accompanied by Mr. J. P. Williams, of the Imperial Tobacco Company and Mr. F. Barker, then Agricultural Officer of South Nyasa. Further tours were made in 1931 and 1937, the latter being assisted by an aerial survey.

The areas to which particular attention was given comprise what is known as the Abenga and Kasitu valleys between Ekwendeni, Jakwa and the Rumpi and the drier parts of the plains to the north of Florence Bay as far as the North Rukuru. Observations were made on the vegetation particularly the grass flora and many soils were examined for acidity, available phosphates and organic matter.

The writer is indebted to several planters, missionaries and District Commissioners for considerable data on weather conditions and native agriculture.

The climate of the zone under consideration has already been described and on the widest stretch of alluvial land south of Karonga between the foot-hill country and Lake Nyasa, the much drier weather conditions during the growing season can be explained by the distance from the mountain areas and the rain-shadow effect of the very high escarpments to the south.

The zone is well watered and there have been constant changes during past ages in the courses of rivers such as the Nyungwe, Wovwe, Remero and Fuliwa. The soils laid down in these numerous river beds and at one time on the floor of the lake have been considerably weathered and re-worked. The soil carried down the steep eastern slopes of the Nyika plateau by the upper reaches of these rivers must also have been in large amount and those soils have been derived not only from the crystalline rocks of the mountain massifs but also from similar rocks of the Ulamu and Maraumba ridges and from various rocks of Karoo formation and the Dinosaur, Chitimwe and Chiwonda beds. (F. Dixey, D. Sc. in Quart. Journ. Geol. Soc. Vol. LXXXIII).

As a result of this deposition and weathering and the growth at one time of a superior mantle of thorn forest, of good Combretum-Acacia so often found on the Lake plains and of palm stands, many of the soil types are well supplied with plant nutrients.

Where the soils become more sandy one is forcibly reminded of parts of the Coastal Plain of the United States where the soils and vegetation not only have a superficial resemblance but the chemical and mechanical composition of such poor sandy soils is very similar.

The most fertile soils are found west and for a few miles south of the Ngara ridge, itself of crystalline formation and covered with poor gravelly soil. These are similar to other fertile soils of the Lake shore and Bwanje valley and are not acid. They generally contain a large amount of available phosphates, exchangeable lime and total potash and may be referred to as Vua alluvium.

Other areas north and south of this area show considerable soil variations. One passes quickly from ridges of crystalline rocks to valleys of alluvium, some of which in the rains form water-logged dambos. Many of these sandy residual and dark coloured alluvial soils are quite acid and support a characteristic vegetation of poor orchard country with a marked absence of panicoid grasses. The most interesting area of the sandy residual soils above the Chitimbe beds is found west of the Mbiri ridge which is of crystalline formation. This area is covered with a narrow belt of woodland with large trees of *Brachystegia* spp. and *Burkea africana* from which at one time many canoes were constructed.

The crops which are normally grown on the soils of this division are mentioned in the short descriptions given below of the various subdivisions. Various types of tobacco can be grown but the present paucity of European planters now rules out any appreciable production of those types such as flue-cured brights which require a considerable amount of knowledge and experience. Furthermore on most of the deep sandy soils, some fertilizers are required for the production of tobacco of high quality and this becomes an expensive matter owing to the distance from rail-head.

The best soils for bright tobacco are well drained, are not acid, are well supplied with lime and phosphates and are similar to those listed as Vua alluvium. Acid soils should be avoided if tobacco of high quality is to be attempted but certain of these soils well supplied with organic matter can be used for the production of dark tobacco types. Unfortunately there is sufficient dark-fired tobacco produced in more southerly areas for market requirements so that beyond a small production of dark air-cured types such as is produced in the lowlands of Ncheu and South Nyasa, native growers cannot be encouraged.

With regard again to the best non-acid soils it is found that many panicoid grass grow well on them. Such are species of *Urochloa*, *Paspalum*, *Brachiaria* and on valley soils well supplied with organic matter species of *Echinochloa* with *Sorghum verticilliflorum*.

It would be expected that on such sandy soils as would be utilized crop plants might exhibit deficiency diseases and this is borne out in the drier areas and in drier seasons by the occurrence of sand-drown or magnesia hunger on tobacco, of drought spotting and specking on cotton and other crops due to potash deficiency, and to the frequent occurrence of fungus diseases on some crops grown on acid sandy soils. It may also be that mineral deficiency in the feed of some of the 3,000 cattle here present may be the cause of their general poor condition.

With the prevalence of so many areas covered with sandy soils it would be expected that the population would be small but it actually reaches 50 to the square mile of cultivable land in the section of Mwafulirwa which covers most of this area.

The Agricultural Supervisor of North Nyasa, Mr. D. N. Smalley, divides the Lake plain south of Kuronga into climatic sections and gives the acreage of land of good and poor fertility which is being used.

				Land of high fertility in use		Good to medium land not in use		Land of low fertility	
				acres		acres		acres	
Florence Bay	...	...		2,000	...	2,000	...	1,000	
Deep Bay, Upper and Lower Hara				10,000	...	30,000	...	2,000	
Nyungwe, Ngara and Vua	...			4,000	...	5,000	...	1,000	
Mlali	...	..	...	4,500	...	3,000	...	1,500	
Kayuni	...	...	...	2,500	...	3,000	...	1,000	

In the Florence Bay section, attention is particularly drawn to the serious erosion of hill slopes which has been accentuated by the methods of cultivation of cassava. The area is suited to cotton, groundnuts, millets, beans, maize and in parts rice. The area is well watered by such streams as the Chitumba or Manchewe and there are possibilities of irrigation for such crops as rice.

The Hara section watered by the perennial Hara and Chananga is reported as capable of very considerable agricultural expansion. The soils are largely light sandy loams with fertile areas of red loams, brown sandy loams and black cotton soils. The Chananga often overflows its banks and deposits silt on good agricultural lands. There are great possibilities of carefully controlled irrigation but near the Lake shore the problem of soil erosion needs careful attention. Almost any type of native food or economic crop could be grown in abundance in the Hara country. Maize, millets, sugar cane, beans, rice, cassava and groundnuts grow luxuriantly everywhere and cotton shows great promise.

The Nyungwe, Ngara, Vua area contains many pockets of fertile land and is well wooded but generally the area is unproductive with a very small population and the water supplies are inadequate although served by the Nyungwe, Wovwe and Gumi. The soils are badly eroded and sandy soils cover large areas. The rainfall is reported as somewhat variable and erratic although the records at Vua and Nyungwe hardly bear this out. At Nyungwe estate a small irrigation scheme has given good results with cotton.



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Example of serious sheet erosion soon after land has been cleared of *Brachystegia* open woodland. Soil of this type with tendency to form hard sub soil pan is common in Northern Nyasaland.



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Severe gully erosion due to clearing of highlands above. This was a shallow depression with a small perennial stream in 1925.

The Nyungwe river also often overflows its bank and deposits silt on good land and it is contended that the Nyungwe and Wovwe could create a large acreage of rich dimba land suitable for late food and economic crop production.

To the west of Nyungwe estate ample acreage for the expansion of food and economic crops on a large scale exists as far as the foot of Nyika mountains ten miles away.

Maize, millets, beans, cassava, groundnuts thrive throughout the locality and cotton has been successfully produced.

Mlali area has suffered worse than others through the rise in the Lake level. To the west the country is poor and ill watered. The Lemero and Gumi dry up in July but there is room for considerable expansion if all the year water supplies are assured.

The soils near the Lake shore are coarse sandy loams badly éroded. Pockets of good usable light soils abound but large tracts of eroded yellow sandy soil are found. In the higher lands towards the foothills, about 3 miles westward there are areas of good brown sandy loams while nearer the hills red loams with pockets of rich black cotton soil are found in the undulating country. Brown sandy alluvium of high fertility is found along the Lemero.

The usual food crops all do well and although early planted cotton did well in 1937 in this and more southerly areas, it is not proposed to encouraged very early planting in these drier zones but to follow the later planting of the Karonga area so that throughout the cotton belt of North Nyasa there will be a dead season of fully two months with no cotton giving anywhere.

The Kayuni section is confined to within a strip of about a mile wide along either bank of the Bwaye river which rises in the Nyika about ten miles west of the Lake shore and usually dries up in early June.

The section is sadly lacking in water supplies a few miles from the Lake which precludes farther expansion in such crops as cotton.

There are some good light sandy loams along the Bwaye but much black cotton soils along the Lake have been inundated.

Wells are needed at Buliwa about 54 miles south of Karonga, at Tunduti about 4 miles west of Buliwa, at Kayuni 4 miles west of the present village, at Thomas 3 miles north of the former, and at Mpwero 2 miles north-west of Thomas.

AGRICULTURAL SURVEY. PART 13.

THE KARONGA—SONGWE PLAIN.

This is in all probability the most important agricultural area of northern Nyasaland and has had considerable attention from Agricultural Officers particularly with a view to improvement of agriculture and animal husbandry and to an extension and improvement in the rice and cotton industries. The type of rice grown has undergone considerable improvement and an account of the whole industry has been well given in Bulletin No. 12 (new series) by F. Barker, C.D.A. (Edin.)—The Rices of Northern Nyasaland.

It can be seen from a description of the climate that there is a considerable rainfall over the area during the summer months. This does little harm to the usual food crops during this season but as a result it is usual to plant tobacco and cotton much later than in more southerly areas.

The Agricultural Supervisor, Mr. D. N. Smalley, divides this plain into the sections of Karonga, Ngerengi, Songwe and Mpata. His descriptions are given below and he gives areas as follows:—

		Land of high fertility in use		Land of high fertility unused		Land of low fertility practically useless
Karonga	...	12,000	...	9,000	...	3,000
Ngerenge	...	12,000	...	4,000	...	3,000
Songwe	...	7,000	...	10,000	...	3,000
Mpata	...	6,500	...	2,500	...	1,500

KARONGA.

This section is confined to the lands lying 4 miles south of the Rukuru River up to 4 miles north of the river and in a westerly direction from the Lake shore between these boundaries.

Rivers. A fine perennial river runs through the centre of this section from the mountains lying some 14 miles west of Karonga situated near its mouth on the Lake shore. Between February and March annually the river usually over-flows its banks several times and thereby enriches the country in close proximity to both banks with rich alluvial silt deposits from the hills. Long narrow dimba lands are thus created that form a rich agricultural asset to the dense population of this prosperous locality. It has been suggested to further increase the available dimba land by the introduction of irrigated crop production at selected suitable points along the Rukuru river. With the expansion of the dimba and late planted cotton in this section now in evidence this step is worthy of early consideration.

It is on record that on occasion in the past and actually during the present season with the Lufira river some 10 miles north of the Rukuru, the waters have failed to over-flow dimba lands for late cotton planting. Millions of gallons of silt laden waters are poured into Lake Nyasa that skillfully applied could perhaps be utilised in part at least for agricultural purposes. Both the rice and cotton crops of this area depend to a great extent for their success upon an adequate and assured water supply for dimba lands.

Soils. This section is a patchwork of the higher types of sandy soils ranging from rich dark brown sandy loams along the river banks to badly eroded and overworked stretches on its outskirts. In general the soils are good and capable of raising adequate food and native economic crops. The dimba land bordering the banks of the Rukuru river is capable of considerable further development for food and cotton crops. Some 4 miles west of Karonga near and around Kyungu's village pockets of rich red sandy loams abound. These extensive areas are still in many instances almost untouched owing to the total lack of surface waters, but with construction of wells at selected points a better population distribution would result and the progress of native agriculture be more reasonably assured.

As is to be expected in a densely populated locality a good deal of usable agricultural land is being rapidly rendered useless by the excessive number of cattle grazing over it, but any interference with the cattle holdings and tribal customs of these Wankonde peoples in these matters would prove an unwise policy for the present at least and be met with strong opposition.

Suggested Crops. It is no exaggeration to state that almost every type of native food crop raised in Nyasaland flourishes in this locality. At present large surpluses of maize, beans, rice and to a lesser degree groundnuts, above ordinary local food requirements, are grown and sold to Tanganyika where a ready sale at attractive prices for ungraded produce exists.

The amount of rice, beans or other crops offered for sale in Nyasaland markets is no real indication to the actual tonnage raised in this area and neighbouring localities of Mpata, Ngerengi and Songwe. Nor has anything like saturation point been attained with any native food crop raised for sale. Properly supervised and encouraged rice, beans, groundnuts and maize and other food crops can be greatly expanded, but as all too often happens in uncontrolled marketing of any produce, the middleman who are in most instances Indian traders in Tanganyika appear to exploit the North Nyasa produce growers to the full.

The time will have soon arrived if it has not already when the practicability and desirability of some form of co-operative marketing for surplus produce through regulated channels should be seriously instigated and tried out.

With the recent introduction of cotton as a follow-on crop after rice and dimba maize, and with the present assured market for any such cotton raised, the people of this locality and its near neighbours are entering upon an era of desirable and well earned prosperity.

NGERENGI. This section is situated some 9 miles north of Karonga and lies from a point about 2 miles from the Lufira River to Mayofia stream some 4 miles north of the Lufira river and stretches from the Lake shore at Kaporo to the foothills some 7 miles to the west.

Rivers. These is only one perennial river in this section, the Lufira, which rises in the Misuku Hills west of the Lake and discharges its waters about 4 miles South of Kaporo. The lesser streams the Kasisi, Moyofia and Chowa are usually dry by June or July. Upon the flooding of the low lands along the Lufira river banks, depends the agricultural wealth and stability of this section. In normal times the river overflows about 3 or 4 times during February and March and enriches the surrounding lands with rich alluvial silt deposits. Unfortunately there are seasons when the river fails to overflow and as a consequence the planting season for cotton is advanced by some month or five weeks and the lack of sufficient water at the right time spells disaster to the extensive rice crops. The present season 1937 is unfortunately a case in point; the river has failed to overflow although ample waters are running into Lake Nyasa. This also applies to the Kasisi stream upon which the experimental rice plots depend for their success. It is urged that a study of suitable irrigation methods is advisable to reduce the present grave risks to the young and at present thriving industries. A considerable extension of usable dimba could be created by the proper and regulated introduction of these rivers waters to adjacent lands.

Soils. The soils of this section are very similar to those found in the Karonga area. Rich light sandy loams abound with extensive heavier black dimba soils along the river banks. Very extensive erosion is in evidence throughout the section owing to overgrazing by cattle. The soils immediately adjoining the Lake shore generally extremely sandy and badly eroded and of not much agricultural worth. West of the Lake towards the foothills of Ngerengi red sandy loams of good quality exist in reasonably large pockets but a good deal of the land there is completely ruined by cattle for agricultural expansion.

Suggested Crops. This section is at present prosperous through its agricultural activities and one of the richest agricultural strips in northern Nyasaland is capable of still further steady development. Every form of native food crop grows abundantly. Rice, cassava, beans, maize and in parts groundnuts are capable of expansion.

The very successful cotton crop in this section in 1936 has had a greatly stimulating effect on expansion in North Nyasa and the area should under suitable supervision become a hive of economic crop industry and an example to any part of Nyasaland of native prosperity. The investigation of irrigation and co-operative marketing as a near future step in agricultural advancement for this and its neighbouring localities are urged.

Songwe. This section lies to the north of the Mayofia river and extends to the Songwe river which is the boundary between Nyasaland and Tanganyika.

The section is mainly confined to the fertile strip of land on the south banks of the Songwe river extending some 20 miles inland from the Lake shore to a width varying from 1 to 4 miles.

Rivers. The Songwe River, a winding all-year-round stream, runs the whole length of the North Nyasa border and separates it from Tanganyika. Like most of the big rivers in these parts the waters overflow the banks several times during the rainy season and enrich the surrounding agricultural lands. Upon such treated dimba lands the main crop activities centre. Such flooding usually takes place between February and March each year. As with the other rivers mentioned in this report the introduction of irrigated crops is not be overlooked.

Soils. Most of the soils around the Lake shore of this section, with the exception of a fertile strip at the mouth of the Songwe river consist of eroded and almost useless sands. This belt of poor land extends several miles inland in places and is unpopulated and of little use. Rich loams, black dimba and black cotton soils are in abundance along the river banks at its whole length for some 20 miles from Lake Nyasa. To the west of the section, some 2 to 4 miles from the lake, a range of low foothills with useful light sandy loams and pockets of rich heavier soils are to be found. These lands near the hills have not yet to any great extent been opened up and developed. As in most localities a great deal of damage to land is being done by overgrazing on these light soils.

Suggested Crops. Agricultural conditions are almost identical with those of Ngerengi; surpluses of rice, maize, beans and groundnuts find a ready sale over the border in Tanganyika.

Both dimba and early planted cotton is being given as extensive trial during the present season and I can see no reason why the same prosperity should not result as exists in Ngerengi by the raising of native economic crops.

The section is capable of considerable further expansion under proper supervision and my remarks regarding such matters as irrigation, and co-operative marketing apply equally to this locality.

MPATA.

This section has in the past usually been associated and treated as one with Karonga, but being situated at the base of the hills some 12-14 miles west of Karonga, climatic conditions appear from the small observations already made by me to differ considerably from those at Karonga or on the Lake shore. The area lies along both banks of the Rukuru river and extends along the foothills some 4-6 miles to the north and south of the river and some 6 miles west of the hills.

Rivers. The Rukuru river winds through this section and the bulk of the agricultural lands at present in use are situated reasonably close to the river banks. As with the Karonga area the flooding of the river enriches the neighbouring lands and some large excellent dimba lands have thus been created. These dimba could be still further increased by the use of irrigation methods at suitable points.

Soils. Along the river banks light sandy loams abound and are being well used. A good deal of badly eroded sandy silt has been deposited from time to time in many places by uncontrolled river flooding and such patches are of little agricultural use. Along both river banks good pockets of black cotton soil and heavy dimba black soils are to be found. In the higher region of the foot hills and around their bases red sandy loams and brown medium sandy loams of good agricultural worth abound. Away from the river banks this type of heavier soil has only been lightly penetrated at present owing to the lack of surface waters and the absence of wells. With the introduction of wells at suitable selected places, the population of the section could be better distributed and the present overcrowding along the river banks somewhat relieved and the agricultural production increased from its present level.

Suggested Crops. Almost every type of native food crop thrives in this locality. Many excellent gardens of maize, millets, cassava, groundnuts, beans, sugar cane and sweet potatoes are to be found. In the past small trials of cotton, both early and late dimba planted, have proved successful and the present season shows a promising increase of both early and late planted cotton. This section is capable of considerable further agricultural expansion with the assured surface or well supplies at selected points and with the introduction of irrigated crops.

Karonga Section. Wells advocated—

(1) At the village of Katolora situated about 1 mile S. of the Experimental Station 2 miles west of Karonga. This well would serve the villages of Katolora and Malema.

(2) At Mwengubwe village in the Mwesaya area situated about 12 miles west of Karonga and about 3 miles south of Mpata. The construction of this well would make this locality which is suitable for agricultural development an early possibility.

(3) At Amon village situated about 5 miles N. W. of the Rukuru river on the Ngerengi road. This well would serve the villages of Amon, Mwafilaso and Donald Nyenda, and open up good agricultural lands.

(4) At Mbemba village situated about 4 miles south of Ngerengi and about 2 miles north of Amon village. This well would serve Mbemba and Mwenitanga villages and make possible the development of those localities.



22

Bringing in the rice harvest. Note the typical flooded country-side.



23

Harvesting rice plots at Kasisi.



24

A *Sanja* erected in the rice experimental area at Kasisi, north of Karonga. These towers are erected for the watchmen who scare away raiders such as hippopotami.

AGRICULTURAL SURVEY. PART 14.

REPORT ON AN AGRICULTURAL SURVEY OF LIKOMA ISLAND.

BY R. W. KETTLEWELL.

Likoma island is some nine square miles in area and separated from the Portuguese mainland by about four miles. The annual rainfall is in the neighbourhood of 40 inches.

Although within living memory the island was moderately well-timbered, it is doubtful if it was ever very fertile; but it is now practically treeless with the exception of a few baobabs and the soil scarcely justifies the name any longer. The island is studded with small hills rising to a maximum height of about 500 feet; and these, though formerly covered by small timber and other natural vegetation, are now little better than a pile of rocks whose interstices are required for the cultivation of cassava. The soil is a coarse sand varying slightly in fertility and naturally being better in the more level valleys between the hills. There are no dimba soils.

The poor agricultural state of Likoma briefly described above is undoubtedly due to over-population; and the present figure of just under 4,000 is said to be increasing steadily. The population density is 420 per square mile. The villages are all situated on the shores of the island, owing to the absence of inland water and to their interest in the fishing industry. The whole of the interior of the island is under cassava cultivation right to the summit of the hills, and no other crop is grown. Indeed it is very doubtful whether any other food crop could be grown with profit without manure, since even the cassava requires two or three years to produce its meagre yield; and even then it cannot alone supply the needs of the population. Additional food is brought regularly in dhows from Chinteché. Not only does the universal cultivation preclude any resting of the soil but it leaves no space for poles and firewood and practically no room for grass, and these necessities are also obtained largely from the mainland. The natives appear to feel the shortage of poles and firewood more keenly than the shortage of food.

Unfortunately it is difficult to avoid the conclusion that little of real value can be done to improve the agricultural condition of the island so long as the population remains as high as at present. No natural regeneration of timber can take place on the hills while the inhabitants are forced by circumstances to cultivate them; but it is clear that scrubby vegetation would reappear if given the chance. Under present conditions, however, the natives cannot set aside any land even for the production of firewood. The only alternative seems to be the planting of road-sides and villages with some suitable trees, and seed for planting this rains would be very welcome. Seed from the msambamfumu trees at the mission station could profitably be distributed; but it would be of great assistance if the Forestry Department could supply seed of a tree suited to poor sandy soil and resistant to white ants—a pest with which the whole island is riddled.

Certain minor agricultural improvements are possible and of these the local chiefs have been informed, but they are unfortunately of the type to which natives do not take very readily at present. The island is nowhere level; but the abundant supply of stones makes terracing and bunding possible, and even though the soil is poor it would be better held in place than washed away. A practice common at present is merely to heap out of the way the stones which hinder cultivation, whereas each stone should go to build small walls as nearly on the contour as the owner of the garden can make them. When this has been done the improvement of the protected soil can be considered. There are a few small herds of cattle and goats on the island, but at present the owners make no use of the manure produced. Unfortunately composting is not feasible since there is no grass for bedding, and every other scrap of rubbish is required for fuel; but the manure could be moved to nearby gardens with great benefit to cultivation and to village sanitation. It is feared that white ants will remove some of the manure from the gardens, but its use should nevertheless be justified.

Naturally in an island such as Likoma stock food is extremely scarce and the cattle are in poor condition. Here again slight help could be afforded by planting nsenjere or elephant grass, in any of the damper places which may be found close to the shore in most of the villages. A few

clumps of nsenjere are to be found near the village of Madimba, but they would be far better transplanted in damper situations where they would spread to useful size, and, by providing a ready food supply, would help reduce the continuous denudation of some of the hills by stock.

The rotation of crops is out of the question, since the soil is not suited to other food crops; and even if the above suggestions were widely adopted they could do little more than prevent further decline of fertility. No radical improvement can be affected unless the population is roughly halved, and the constant excessive demands on the soil considerably reduced. The native inhabitants, however, entertain no thought of moving, and state that they prefer the agricultural difficulties of Likoma to conditions of plenty elsewhere. It may be assumed, therefore, that no real agricultural improvement can be achieved without the enforced emigration of half the present population. Should this ever be undertaken a suitable place for resettlement might be found in Native Authority Kanyenda's section (Kota Kota) where U. M. C. A. schools and mission facilities are available, and the people are akin to the inhabitants of Likoma.

AGRICULTURAL SURVEY. PART 15.

SPECIAL ASPECTS OF VARIOUS FOOD AND ECONOMIC CROPS IN NORTHERN NYASALAND WITH TWO GLOSSARIES OF VARIOUS SPECIES GROWN THERE, WITH SCIENTIFIC AND VERNACULAR NAMES.

The report on the Agricultural Survey of Central Nyasaland (1933) in part 4 gives data on various food and economic crops which grow well in those areas with a monsoon climate with the summer rains somewhat on the high side. The short term crops therein mentioned and listed should have equal success in northern Nyasaland with a similar climate such as is found in Kota-Kota, Kasungu and Mzimba, and reference may be made to this report for various data.

In the case of long term crops such as cotton and pigeon pea, the low temperatures of the winter period when the crops are coming into bearing results in a very small yield or complete failure. Also the higher rainfall of northern Kota Kota and of West Nyasa in most seasons results in complete or partial failure of tobacco, cotton and simsim.

In view of the wide range of conditions in northern Nyasaland it is not thought necessary to discuss further than has been done in individual reports of this survey various aspects of numerous food and economic crops especially as it will be a long time before most of the latter reach any importance in economic progress. Also mainly from a climatic point of view suitable crops are listed in part 1.

Naturally in field work most attention will be paid by agricultural officers eventually to ensure that the people obtain an adequate and balanced food ration and this matter, as was done in the survey of Central Nyasaland, should always be stressed. The work now being done on the nutrition of natives in Kota Kota and Zomba by Dr. Pratt and his co-workers should be of great value in this connection.

It has been seen during the course of the survey that natives cultivate many varieties of maize, kaffir corn, wheat, finger and bullrush millets, sweet potatoes, cassava, finger potato, yams and other root crops, beans and many other leguminous plants, gourds and pumpkins, bananas, simsim, and several fruits such as the papaya and mango; minor vegetables such as *Brassica* and *Barbarea* spp. are grown in the winter and wild fruits such as those of the *Uapaca* spp. *Treculia africana* (Bread fruit), *Ficus* spp., *Strychnos*, *Diospyros* and *Syzygium* spp. are eaten in season.

Altogether, if the varieties of cereals and root crops are counted individually, native cultivators in many areas have at their disposal over one hundred different food crops.

Space precludes the publication of the results of investigation into the varieties which must be done on each species by the officer concerned and as Mr. F. Barker, C.D.A. (Edin.) has done in the case of the Sorghums of South Nyasa.

For note on finger millet, see page 39.

There is still much work to be done however in the establishment of a permanent agriculture which shall in addition to providing a sufficiency of all food factors also maintain and improve the fertility of each soil type.

The only products which have been exported in large amount are cotton, tobacco, rubber and rice and this is likely to be the case for some time.

Rice and cotton have been dealt with in detail elsewhere and Para rubber remains a plantation industry on the African Lakes Corporation estate at Vizara where climate and soil conditions are unique.

Rice is likely to become an important export crop from the Lake littoral owing to the efforts of District and Agricultural Officers concerned and to the installation of machinery at Kota Kota. It is hoped to increase the production of rice in North Nyasa where the possibilities are more favourable than elsewhere.

Tobacco has been produced in all northern areas; bright tobacco on European estates in North Nyasa and Kasungu, dark fired tobacco by native growers in Kota Kota, Kasungu and North Nyasa and some sun and air cured types in Kasungu. Unfortunately, owing to the paucity

of land now owned by European settlers and to the large production of dark tobacco elsewhere, it is unlikely that, with the possible exception of brights in Kasungu, the production of the types of tobacco mentioned will ever reach any appreciable quantities.

It is maintained that the drier areas of North Nyasa and Mzimba and nearly all Kasungu possess a climate which is quite suited to the production of various types of tobacco of good quality. These areas may be traced on the summer and autumn rainfall map by the isohyet of 36 inches. Also later plantings of some types meaning that the crop is harvested in the winter period may do quite well in the wetter areas of North Nyasa just outside the drier areas.

Bright tobacco varieties should grow well in Kasungu, Mzimba and in the Vua-Ngara littoral. There are difficulties likely to be encountered and these must be carefully watched. The experience of several seasons may be necessary before the planter obtains the best results. Fertilizers for the sandy loams and for sandy soils, which are likely to be used most largely, will be an expensive item but it may be essential to use phosphates to get good colour and ripening or even magnesia compounds to reduce sand-drown. Leaf diseases such as frog-eye may have to be carefully combatted. Well constructed tight barns especially for late curing will be essential.

The dark fired tobacco now produced on the better soils of Kota Kota and Kasungu is sold at Mponela market and this industry cannot be extended for the United Kingdom market. However a small extension for the West African markets may be made and long narrow thin leaf both fired and air-cured should be produced.

Turkish tobacco should do well in Kasungu and Mzimba and cigar tobacco should grow well in parts of West Nyasa.

Grasses for hay and pasture deserve special mention in this section.

It has been stated that two-thirds of the five northern districts are high-altitude areas covered with grassland downs or lands of generally low fertility. It will also be seen that among the cattle owning people in the lowlands much of the land is almost at the point of over-stocking with all its attendant evils. There is evidently room for adjustment of the cattle population, the intelligent use of higher areas and an improvement in the grasslands. At present there can be said to be no veld management in such aspects as rotational grazing, introduction of improved varieties or superior exotics, early controlled or a minimum of burning of herbage and some manuring.

As first steps towards this improvement a study has been made of the species of grasses present in northern areas and also there are numerous trials on the Zomba Experimental Station of introduced species and better varieties which can be eventually grown in the north.

A list of grasses with a few notes has been added in the appendix on vegetation and a collection has been added to the herbarium in Zomba which may eventually assist workers in northern grasslands.

Cotton is the most important economic crop in northern Nyasaland and has reached a large production in the lowlands of Kota Kota and North Nyasa. Elsewhere production is likely to be negligible.

The work of the Empire Cotton Growing Corporation on the Nkwali Experimental Station is of great value to the northern industry and is closely followed by the officers engaged in these cotton growing areas who have been responsible for parts 5, 9, 12 and 13 of this report.

To emphasize the unsuitability of the Kasitu valley and the Akamanga country of Cikulamayembe the reports of the Entomologist and the Cotton Specialist on these areas are reproduced in full.

REPORT BY THE ENTOMOLOGIST, CAPT. C. SMEE, M.C., D.I.C.

In my report dated 19th November, 1936 on the Kasitu river valley and the Nkamanga plain (N. A. Chakulamaembe's village area) I suggested that an experienced member of the E. C. G. C. staff should be asked to express an opinion on these areas.

I have now had the opportunity of accompanying Mr. H. C. Ducker through these areas, and also of examining in co-operation the widest part of the Kasitu river valley in the company of Mr. B. C. Charles, the Agricultural Officer stationed in the area.

Mr. Ducker's own report is attached and I would call attention to his trenchant remarks on the soils and climatic conditions of these areas from the point of view of cotton cultivation.

This visit has, in my opinion, amply confirmed the views I expressed in my previous report, and the very reliable information obtained from the Head of the Overtoun Institute as to the occurrence of frost in these areas in four years out of five in the month of June, adds a further, climatically, disadvantageous factor to those already known—altitude and lack of suitable soil in quality and quantity.

I need not repeat the information already given in various reports on the subjects of altitude, rainfall and temperature, but I wish to stress as emphatically as I can the fact that, in the two areas with which I am dealing, there is no available land suitable for cotton cultivation that is not required for the production of food crops.

I fear this point has been somewhat overlooked in the much time and thought that has been given to the subject by all those desirous of devising some means whereby the general conditions and welfare of the people living in these areas can be improved.

But in my opinion, leaving out of consideration for the moment all other factors affecting the successful cultivation of cotton, this matter of available land is of the greatest importance.

If the position were such that a strong, healthy African-grown cotton industry could be built up and as a result thereof the general status and welfare of the people would, with no uncertainty, benefit even in small measure, it would be reasonable to view the problem from another angle and devise ways and means whereby the production and supply of the necessary food crops might be overcome.

In actual fact, however, the smallness of the area of suitable soil alone would, in my opinion, and I believe Mr. Ducker concurs, preclude the establishment of an industry that could ever warrant or support the importation of food supplies from outside sources.

In support of this contention I would point out that true riverain alluvial soils in the vicinity of the confluence of the Kasitu and South Rukuru rivers are extremely meagre, if not almost altogether absent. This part of the valley is submitted to be the widest section, but it was crossed by Mr. Charles and myself, from the *Brachystegia* ridge on the Jakwa gorge side to the similar ridge on the further side, walking at 3 miles per hour, in a matter of 25 minutes, inclusive of a few minutes delay in fording the Kasitu river. I had already believed the width of the area between the two infertile *Brachystegia* ridges to be very small but I had certainly expected it would be rather more than one mile. Moreover this distance of one mile contains the Kasitu river bed and at least one other water-course, and also there is quite a large part of it adjacent to the eastern *Brachystegia* border that is obviously non-cultivable, being a mass of converging native paths and used only for sparse grazing at this time of year, in all probability being water-logged during the rains. It is likely that similar areas occur along the length of the valley. The entire remainder of the area, where possible, is used for food crops, and the soil is more of the 'dambo' type than alluvium or 'madimba'.

It is interesting to record that it is in this very area that mythical "excellent" cotton crops were reputed to have been grown in the past.

As has been said this section is the widest part of the lower Kasitu valley and there can be no doubt but that the conditions seen here are representative of what occurs through the length of the valley towards Ekwendeni.

The area north of the confluence of the Kasitu and South Rukuru rivers can be eliminated from consideration as potential cotton country.

It will be seen from Mr. Ducker's report that the Nkamanga plain (Chakulamaembe's village area), which from soil considerations alone might appear to offer the better prospects in the two areas of success with cotton, possesses climatic factors that would render the production of a crop extremely precarious. In addition this area is certainly one of the main sources of food supplies.

I cannot believe that any of the other—and smaller—river areas in the district are devoid of the disadvantages occurring in these major ones. Such areas, also, all lie further to the west or south-west rendering transport to market an even more difficult and expensive matter with consequent decline in value of the crop to the producer. It is well to remember that a year ago, when cotton prices were vastly different to what they are now and a tremendous drop was not foreseen, the highest price that could be offered in these major areas nearest the lake was $\frac{1}{2}$ d per lb for No. 1 seed-cotton, after some 15 miles transport to market by the grower.

Taking all factors into consideration I would unhesitatingly say that it would be unwise to encourage cotton growing in these areas. The crop could only be grown at the expense of much needed food-crop land; its consistent success would be very problematical; and any practical benefit accruing to the population would be doubtful.

REPORT BY H. C. DUCKER, COTTON SPECIALIST, E. C. G. C.

TERRAIN AND CLIMATE.

The plateau country from Mzimba northwards is much dissected by various river valleys. It consists for the most part of areas of poor leached and/or eroded soils carrying *Brachystegia* spp. and *Uapaca* spp. which are of no interest whatever from the point of view of cotton.

Along the various rivers, in varying width but for the most part in narrow strips only, are areas of riverain alluvium. Of these the most important are the alluvial areas of the Kasitu and South Rukuru valleys. The Kasitu valley and the Henga valley section of the south Rukuru form for all practical purposes one area which separated from the balance of the South Rukuru areas by the range of hills through which the South Rukuru has cut the Jakwa gorge. The south Rukuru areas upstream of the Jakwa gorge consist of fringing alluvium along the Rukuru itself and certain tributaries. The most important area, the Nkamanga country, being part of the Lunyina flood plain.

The gorge forms a most interesting boundary in several ways, and particularly so from an ecological standpoint. It marks a change over from the *Brachystegia* of the Kasitu/Henga valley slopes to a more xerophytic type of vegetation. The dominant species in the non-flood to the west of the Nkamanga plain being *Acacia* and *Commiphora* spp. This would indicate that the rainfall here is less than in the Henga valley. Enquiries suggested that the rainfall grows less as one proceeds from east to west in the north Nyasa plateau areas, and that the Nkamanga country lies in the twin rain shadows of the Nyika and the Vipya. The upper Kasitu valley is almost certainly in the Vipya rain shadow.

Proceeding eastward from the Henga valley to Nchenachena and Livingstonia the country rises from the general level of about 3500' at which the valleys referred to above for the most part lie, to some 4000-5000 feet. The soils around Livingstonia are derived largely from Karroo measures and are of a much superior quality to those of the rest of the Mzimba district. They are, however, at too high an altitude and in too humid a climate for cotton to be considered.

The rainfall in general in the areas visited would appear to commence somewhat later, and continue somewhat longer than that of southern Nyasaland, January/April being the months of most rain as opposed to December/March. But there is naturally a great deal of variation according to the particular site in consideration and its relation to the various mountain masses. As mentioned above rainfall would appear to be considerably less as one proceeds westward from Livingstonia, and the Nkamanga area distinctly dryer than surrounding areas.

It seems highly probable from information vouchsafed by the Reverend Galbraith, that all possible alluvial areas and in particular the Nkamanga area of Chakulamaembe's country, are liable to frost in June.

TRANSPORT

Communications between the Plateau areas and the Lake shore, whence cheap freight by water to rail head is possible, would appear to be both difficult at present and not easy of improvement. They are likely to prove a major obstacle to cotton development even though other conditions, and it will be suggested later that these do not permit this to take place.

COTTON IN THE PLATEAU AREAS.

Soil conditions indicate that cotton can only be considered a possible crop in the various alluvial areas, of which the Henga/Kasitu and Nkamanga areas are the chief. Other alluvial areas exist but are small in comparison. Even the two areas named are small in relation to the rest of the country; a very large part of this acreage is already in use for food crops, and there is evidence that cotton could be planted only at the expense of such crops.

The non-alluvial areas and such alluvial areas as carry *Brachystegia* spp. are useless for cotton growing on a commercial scale.

Such evidence as is available in regard to climate indicates that the possibility, probability is a better way to put this, of frost means that cotton in the plateau areas must be essentially a summer crop. The rainfall distribution is such that an early start seems unlikely in most years, mid-December at the best, so that a very short season is available. Any delay to the sowing, or to growth due, say to a flood in the Nkamanga plain, will be fatal to the crop.

The survival of Tree, or Kidney, Cotton, *Gossypium peruvianum*, cannot be taken as evidence that the area is suited to a commercial crop, which to be a success must give consistent results. Even a slight delay in flowering will bring the cotton into the main incidence of stainers, *Dysdercus* spp. and ruin the crop. There are abundant host plants in the areas which could provide such pests and *D. fasciatus* was observed in quantity on 'Mtowo', *Thespesia regeersii*, near the Jakwa.

The considered opinion of the writer is that, transport and other difficulties apart, the areas under consideration are unsuited to a cotton crop which is entirely dependent on rainfall. And frost would make out-of-season cotton grown by irrigation a risky proceeding.

He can envisage a season when chance rainfall provided an early start, say in mid-November to early December, while the remainder of the season was such that cotton flowering in March made a satisfactory crop, but would imagine that such a season would be very exceptional from such evidence as is available.

TWO GLOSSARIES.

A. GLOSSARY OF CROPS AND USEFUL PLANTS WHICH GROW WELL IN MOST OF THE WARMER PARTS OF NORTHERN NYASALAND WITH NOTES ON FREQUENCY, ETC.

Specific Name	English Name	Native Name mostly Cinyanja	Remark on frequency, etc.
<i>Acacia arabica</i>	Gum Acacia	Chisio, namelonga	rare
<i>Persea americana</i>	Avocado Pear		rare
<i>Acacia molissima</i>	Black wattle	...	Mist belts only
<i>Aloe spp.</i>	Aloe	lisongwe	Open woodlands
	(Several species)		
<i>Bixa Orellana</i>	Annatto	..	Few trees only
<i>Voandzeia subterranea</i>	Bambarra groundnut	Nzama	
<i>Orytenanthera abyssinica</i>	Bamboos	tsungwi	Plentiful in hill regions
<i>Musa Cavendishii</i>	Banana, Cavendish ..		rare
<i>Musa sapientium</i>	Banana	nthochi	Staple food of Wankonde
<i>Musa buechananii</i>	Wild banana	mzukuluzuku	
<i>Phaseolus vulgaris</i>	Beans haricot	nyemba, kayera	} General in small areas
	" <i>Phaseolus</i>	mbwanda	
	" "	cimbamba	
<i>Phaseolus mungo</i>	" mung	mpodza	rare
<i>Setaria italica</i>	Boer manna or fox-tail millet	nkotikoti	Introduced as substitute for finger millet
	Broom corn		
<i>Pennisetum spp.</i>	Bulrush or pearl millet	machiwere	Comparatively rare
		nachacha	very rare
<i>Eragrostis spp.</i>	Buckwheat	...	very rare
<i>Canavalia ensiformis</i>	Jack or sword bean	...	rare
<i>Alcurites triloba</i>	Candle nut	...	Few trees near Lake shore
(<i>A. mouluccana</i>)			
<i>Saccharum officinarum</i>	Sugar cane	mzimbe	Some large patches
<i>Anacardium occidentale</i>	Cashew nut	mkaju	Several trees in Kota Kota
<i>Capsicum annum</i>	Capsicum, white pepper	nsobola	Few plants near some villages
" <i>frutescens</i>	Chillies, African pepper		Few neglected trees in many villages
<i>Carica papaya</i>	Papaya	papaya	Most villages
	Cape gooseberry	...	rare
<i>Manihot utilisima</i>	Cassava	cinangwa	Many varieties in all areas.
<i>Ricinus communis</i>	Castor oil	nsatsi	Common, often self sown near village wastes
<i>Croton pentandra</i>			
<i>Bombax sp.</i>	Kapok or cotton tree	mlongela	Few trees near villages
<i>Cicer arietinum</i>	Chick pea	...	Grown by Indians
<i>Cinchona spp.</i>	Cinchona	...	absent
<i>Citrus medica</i>	Citron	...	absent
<i>Citrus sinensis</i>	Orange	malalanje	Few trees near villages
" <i>limonia</i>	Lemon	mandimu	Numerous near Chinteché
" <i>aurantifolia</i>	Lime	...	
<i>Cocos nucifera</i>	Coconut palm	...	Few trees near Karonga
<i>Coriandrum sativum</i>	Coriander	...	Few plants grown by Indians
<i>Sorghum spp.</i>	Corn, Kaffir	mapira	} Many species in lowlands
	" Broom	lumbwi	
	" Cotton	thonje	
<i>Gossypium spp.</i>	" kidney	...	
" <i>brasiliense</i>			
<i>Vigna unguiculata</i>	} Cow pea	khobwe	rare
<i>V. sinensis</i>			
<i>Crotalaria spp.</i>	Sunn hemp	...	Numerous wild
<i>C. senegalensis</i>		...	species which could be used for green manure
<i>C. cephalotes</i>		...	
<i>C. laburnifolia</i>		...	
<i>Croton spp.</i>	Croton oil seed,		
" <i>megalobotrys</i>	several species		
<i>Cucumis sativus</i>	Cucumber	nkhaka	Dimba crop, rare
<i>Hyphaene crinata</i>	Doom or fan palm	ngwalangwa	Common on Lake shore
<i>Dioscorea spp.</i>	Yams	chilazi	} Comparatively scarce in native gardens
" <i>alata</i>	White yam	...	
<i>D. bulbifera</i> and		zinkhowe	
<i>D. triphylla</i>		mpama	

Specific Name	English Name	Native Name mostly Cinyanja	Remarks on frequency etc.
<i>Dolichos lablab</i>	Dolichos bean	nkungudzu	
<i>Colocasia esculenta</i>	Eddoes and Tania		
" <i>antiquorum</i>	Taro		rare
<i>Xanthosoma sagittifolia</i>	Taro		
<i>Eloeis guineensis</i>	Wild Palm Kernel		Trees in West Nyasa
<i>Solanum melongena</i>	Egg plant		rare
<i>Eleusine coracana</i>	Finger millet	Mawere, Rupoko Malesi	Frequently grown, several varieties
<i>Tephrozia vogelii</i>	Fish poisons	ombwe	Common in some villages
<i>Mundulea sericea</i>			
<i>Lagenaria vulgaris</i>			rare
	Fibres	lichonya, mala- mbe chiwale	Numerous indigenous and introduced
		denje nzonogwe,	
		bwaze	
<i>Cucurbita maxima</i>	Gourds and pumpkins	mponda, maungu	
<i>Passiflora</i> spp.	Granadilla	magalegedela	
<i>Citrus maxima</i>	grape fruit, etc.		rare
<i>Arachis hypogaea</i>	Groundnut	ntedza	Common
<i>Psidium guajava</i>	Guava	Gwafa	very rare
<i>Cannabis sativa</i>	Hemp	mbanje	rare
<i>Phoenix reclinata</i>	Palm, wild date	Kanjedza	Common
<i>Hevea brasiliensis</i>	Para rubber	mpira	Plantation in West Nyasa
<i>Hibiscus esculentus</i>	Okra		rare
" <i>sabdariffa</i>	Rosella		Frequent in some villages
	Olive		Few trees only
<i>Allium</i> sp.	Onion	anyenzi	rare
<i>Indigofera</i> spp.	Indigo plants		common
<i>Ipomoea Batatas</i>	Sweet potato	mbatata	common
	Japanese barnyard millet	cindumba	fairly common
	Kapok		
<i>Landolphia kirkii</i>	Landolphia vine		
	Lablab bean	nkungudzu	Isolated small areas
	Lettuce		rare
<i>Lens esculenta</i>	Lentil		very rare
<i>Litchi senegalensis</i>	Litchi		absent
<i>Phaseolus lunatus</i>	Lima beans		rare
	Loquat		very rare
<i>Luffa cylindrica</i>	Loofah		rare
<i>Coleus dazo</i>	Madagascar potato		
" <i>esculentus</i>	Livingstone potato	mbuye, njowela,	Commonly grown in small patches
" <i>tuberosus</i>	Peanut potato	nyumbu, numbu	
<i>Mangifera indica</i>	Mango	mango	Common
<i>Citrullus vulgaris</i>	Melon, water		rare
<i>Mucuna</i> spp.	Mucuna or velvet beans	kalongonda	rare
<i>Morus alba</i> and <i>M. indica</i>	Mulberry		common in some villages
<i>Ocimum americanum</i>		canci, msanyani	common aromatic weed
<i>Hibiscus esculentus</i>	Okra		few plants
<i>Olea europaea</i>	Olive		A few trees in North Nyasa.
<i>Elaeis guineensis</i>	Palm kernel, wild	kajindo	Trees in valleys of West Nyasa
<i>Borassus flabellifer</i>	Palmyra	nyumbo	common. Seed carried by elephants
<i>Piper nigrum</i>	Pepper, black		Absent
<i>Ananas comosus</i>	Pine apple	chinanasi	Common in West Nyasa
<i>Pisum sativum</i>	Pea		Common as dinba crop
<i>Cajanus cajan</i>	Pigeon pea	nandolo	Some on Lake shore, rare in hills
<i>Amaranthus spinosus</i>	Pig weed	banongwe	Common where cattle are kept
" <i>blitum</i>			
<i>Musa paradisiaca</i>	Plantain		
<i>Cucurbita pepo</i>	Pumpkin	maungu	Common
" <i>maxima</i>	Giant pumpkin		rare
<i>Panicum miliaceum</i>	Proso millet	nkwanje	
<i>Oryza sativa</i>	Rices	mpunga	see Bulletin No. 12. (N.S.)
<i>Lactuca sativa</i>	Salads from lettuce, etc.	ndiwo	Leaves of many plants are used as vegetables
<i>Sansiviera</i>	Sansiviera or bow string hemp	bwazi	rare
<i>Echinochloa colona</i>	Shama millet	mphunga	Wild and common. Eaten in times of scarcity
<i>Sesamum indium</i>	Sim sim	chitowe	Common
<i>Agave sisalana</i>	Sisal	khonje	

Specific Name	English Name	Native Name mostly Cinyanja	Remarks on frequency etc.
<i>Brassica juncea</i> , etc.	Spinach	ntanaposi	Made from various weeds and cultivated plants e.g. <i>Brassica juncea</i>
<i>Glycine max</i>	Soya bean		Recently introduced
<i>Strophanthus sp.</i>	Strophanthus	khombe	Khombe is only species of value, rare
<i>Canavalia ensiformis</i>	Sword bean		rare
<i>Thea sinensis</i>	Tea		Very small acreage at Vizara
<i>Citrus nobilis</i>	Tangarine orange		
<i>Nicotiana Tabacum</i>	Tobacco	fodya	European grown
" <i>rustica</i>	"	labu	Grown in dimba at end of rains
<i>Lycopersicum esculentum</i>	Tomato	pbwetekere	Common, often wild.
<i>Curcuma longa</i>	Turmeric	cikasu	rare
<i>Dioscorea spp.</i>	Yams	mpama	rare
<i>Vetiveria zizaniodes</i>	Vetiver grass		rare
<i>Triticum vulgare</i>	Wheat	trigu	Common in Ahenga hills

B. GLOSSARY OF TREES BEARING EDIBLE FRUITS.

Specific Name	Yao Name	Other Native Names G—General, To—Tonga N—Nyanja, T—Chitumbuka
<i>Uapaca kirkiana</i>		masuku (G)
" <i>nitida</i>	ndoto	kasokolowe (N, To)
	maposa	mapoza (N)
<i>Strychnos spinosa</i>	ngulukututu spp.	nziru (N)
" <i>quagua</i>		mteme (N)
<i>Syzygium spp.</i>	n'gwen'gwe	musu (N) katope
	ndawa	nthema (N)
	chanadimbo	chamdimbo (N)
<i>Diospyros</i>	sakalawe	mbilima (N)
<i>Tamarindus indica</i>	mkwesu	bwemba (Y)
<i>Adansonia digitata</i>	malambe	malambe (G)
<i>Landolphia kikii</i>	maongo	makombe (N) mtwatwa (T)
	ndundula	mzimu (N)
<i>Mimusops sp.</i>	mbimbinyolo	mphimbinyolo (N)
<i>Hyphaena crinata</i>	—	ngwalangwa (G)
<i>Treculia africana</i>	—	maja (G)
<i>Swartzia madagascariensis</i>	dzungu	mlundu (T)
<i>Antidesma venosum</i>	mpululu	mpungalira (N) sirika (To) mpikama- ungu (N) mserera (T)
<i>Ficus capensis</i>	nkuyu	nkuyu
<i>Parinari mobola</i>	—	muura (T)
<i>Bauhinia articulata</i>	—	chitimbe (G) muntukutu (T)
" <i>Thonningii</i>	—	
<i>Catha edulis</i>	—	mstawari
<i>Pterocarpus angolensis</i>	—	mlombwa (G)
<i>Trichilia emetica</i>	—	msikitsi (G)
<i>also</i>	mngulugulu	makaikai
—	nadyakamba	ufukula
—	ndola	chikandola
—	itili	mankhwe
—	mbembu	maula, matowo, ntondooka (G) mbinji (G) ngundi (G)
<i>Kigelia pinnata</i>	—	mvunguti (G), baked fruits used in beer only

AGRICULTURAL SURVEY. PART 16.

DENUDATION AND SOIL EROSION IN NORTHERN NYASALAND.

BY A. J. W. HORNBY, M.B.E., B.Sc., A.I.C.

It will have been noted in the individual reports from officers engaged in this survey, that reference is constantly made to the deterioration of soils due to abnormal soil erosion. In this respect the results of uncontrolled and unwise clearing of land in northern Nyasaland are just as bad as those obtaining in more southerly areas. The writer has continually drawn attention to these evils since 1923 and has endeavoured to lay-off and construct various arrangements for minimising soil erosion together with numerous experiments and trials of crops for soil renovation and maintenance of fertility. Much of this work has been done on the red lateritic and other sandy loams of the Zomba Experimental Station but other schemes have been laid down in other northerly districts so that the results of considerable experience are at hand.

Reference may be made to the publications of the Department for the description of arrangements advocated to reduce the amount of surface soil removed to lower levels during the rains. These have been described in detail in Bull. No. 11 (n. s.) and it is considered that on the soils of northern Nyasaland no time should be lost in instituting a campaign among cultivators to show the value of these arrangements.

It is desired to emphasize at this stage that this problem must be tackled in a proper manner before it is too late. As a result of careful observation by experienced officers in many northern areas where cultivators are finding it difficult to obtain sufficient food from impoverished gardens it is quite apparent that the future expenditure on supervision and labour necessary to keep the fertility at its present level will become very great indeed. As each year passes with nothing really effective being done this necessary expenditure will increase in geometrical ratio.

If the erosional damage in a few years assumes great proportions just as it has in the glaring examples of Eastern Asia, it may be asked how it is proposed to assist the native to obtain his food or where it is proposed he should be moved to be able to cultivate land of higher fertility.

The illustrations accompanying this report should emphasize the great damage which is being done by sheet and gully erosion. The former occurs on all the gardens of the plains and littorals and the latter every year is becoming more obvious, being particularly bad in the Misuku highlands, in southern Mzimba and even in the partially cleared *Brachystegia* country of Kota Kota and North Nyasa.

Little more need be said here but again it is advocated that experienced officers should be allowed to concentrate on this problem and although they would utilize as many agricultural methods for soil improvement, with as reasonable an expenditure as possible it is obvious that certain arrangements such as well constructed Mangum and Nichols ridge terraces are very necessary everywhere and that those should be carefully laid off with an accurate level.

Concomitant with the use of various arrangements for reducing soil erosion will eventually be the much greater use of manuring and in this connection attention is drawn particularly to the manufacture of Indore compost. This is the best of all materials for depleted soils which can be made in large quantities by the native cultivator near his village. He can utilize all animal and vegetable wastes and even eventually human and village wastes for the manufacture. He has everything to hand to make a satisfactory product and again no time should be lost in the training of a large number of cultivators in the whole process. This may well be studied in its entirety on the Zomba Experimental Station where production now reaches 400 tons per annum.

Many degraded surface soils of Mzimba require 3 tons per acre to bring them back to a fertility from which a reasonable yield of maize or other food crop can be obtained. It will easily be seen that thirty thousand tons of Indore compost are required in the poorer areas at the present time to ensure that no food shortage will occur. In a few years time the requirement will be trebled and it may be that at that time the strength and capacity of the average family are beyond such an effort.

AGRICULTURAL SURVEY. PART 17.

GENERAL CONCLUSIONS OF THE SURVEY.

BY A. J. W. HORNBY, M.B.E., B.Sc., A.I.C.

INTRODUCTION.

It will be noted that the five most northerly districts of Nyasaland now referred to as northern Nyasaland contain a great diversity of soils and climate and for the purposes of this survey areas with similar conditions of soil and climate have conveniently been described as agricultural divisions and have had individual attention from the officers concerned.

The use of such named divisions facilitates the collection and correlation of rainfall, temperature and humidity records and the study of the distribution and properties of soil types.

These divisions are based on similar lines to those of central Nyasaland, to a survey of which reference may be made for data on similar soils, vegetation and climate in those areas at a high elevation. Unfortunately in the whole of northern Nyasaland there are no large areas of fertile soil with a climate suited to the production of high priced crops such as we find in the Lilongwe dark tobacco belt, the cotton areas of eastern Dowa and Dedza and further south in the tea belts.

LAND OF NO PRESENT VALUE.

Indeed included in these agricultural divisions or in broken country separating these main divisions are large areas which owing to the great variation in rainfall and temperature over a short distance, the general steep slopes, the prevalent low fertility and poor vegetation cover can take no part for some considerable time in assisting economic progress. It is computed that at least one third of northern Nyasaland is covered by such dividing areas which do not fit into any recognized climatic or soil zone.

If to this is added the areas of high altitude covered with grasslands which are only suitable for the grazing of stock, then it is found that two-thirds of northern Nyasaland can take no part for some time in agricultural development.

MAINTENANCE OF SOIL FERTILITY.

Furthermore it is quite obvious that one of the most striking aspects of economic progress in all the recognized zones is the necessity of maintaining fertility, and even of improving fertility in many of the soils under cultivation at the present time, or again in those under bush fallow which will be required to grow food crops in a few years time.

It has been noted in the survey of central Nyasaland that shifting cultivation is not a system which is in any way worth preserving and with the available data on population density, number of livestock and soil fertility of northern Nyasaland under consideration, it is now advocated that shifting cultivation should be definitely discouraged. It is of course admitted that it will take about twenty years of hard work on the part of numerous agriculturists to make many changes in the systems now in operation and destructive of so much vegetation and soil humus but it is maintained that in twenty years time the population in some cultivated areas will have doubled and have reached 300 to the square mile. There will be no room for shifting cultivation and unless much demonstration and educational work is put in before that date then there will be much widespread distress on the over-populated land. Good food crops are obtained for a very long period on many good red loams of the upper Abenga valleys, the Mzimba-Kasungu highlands and of West Nyasa provided there is a paucity of manuring and rotation for short periods with bush fallow. Fertility however gradually falls off and it is here maintained that, if native cultivators are led to increase their manuring, the period of time these soils will give good crops can be very considerably extended. Other methods of soil conservation will indefinitely extend that period. Practically with a certain amount of labour expended on such methods over the same period as opposed to an equal amount of labour involved in a shifting system in vogue for that period accompanied by soil washing, it is possible to obtain better results in crop yields. Monetary considerations do not enter into the argument as such work as manuring, compost manufacture and ridge terracing will be the work of the family. Again however it may be emphasized that there is a vast amount of work to be done of which hardly the fringes have been touched.

In connection with the necessary future work reference may be made to field experiments to prove that certain methods of soil treatment are the best. On the experimental stations of Zomba and Makwapala are examples of intensive cultivation of two types of soil. On the former certain intensive methods have succeeded in maintaining crop yields at a high level but on the latter they have signally failed to do so. (See Annual Report of the Department, 1936).

Numerous writers have persisted in saying that there must be an adequate study of native methods of agriculture before attempts are made radically to change them. On the other hand it is considered that on soils at Zomba and Lilongwe which have their counterparts in northern Nyasaland we have succeeded in proving how fertility can be maintained over long periods. It will be noted that only certain soils have been specified above.

SMALL HOLDINGS.

The proper direction of the family work on small but definite areas of land will eventually lead to the institution of small holdings and this work with selected cultivators will in all probability be the best line of approach to the problem. Further than this the institution of "better farming" villages will in course of time result and this will mean much close co-operation between administrative and agricultural officers.

A small holding scheme also involves in cattle areas improved methods of animal husbandry and also management of woodland areas near the villages from which supplies of essential timber and firewood will be assured for a long time. These matters again mean much close co-operation between the departments of agriculture, veterinary science and forestry.

[A small holding scheme has been in operation on the Lilongwe Experimental Station for some years.]

LAND OF A LOW ORDER OF FERTILITY.

It will be inferred that the introduction of improved methods of agriculture will have most chance of rapid success on the better soils mentioned above. A much greater problem is presented on the soils of medium to low fertility found over large areas in the South Rukuru and Kasitu valleys and especially in Kasungu. The downward trend in such soils after clearing occurs much more rapidly than on the better soils and often two to three years of cultivation means an infertile soil. On these soils again one of the worst methods of native cultivation is employed. This is the *vizozo* method of burning large quantities of timber and brushwood on finger millet gardens. The method with all its attendant evils has been described in full detail elsewhere, attention having been drawn by the Department to the matter for many years and experiments having proved that high yields can be obtained with other good methods which do not reduce fertility.

The *vizozo* method used on the inferior soils is indeed but one example of methods of native agriculture which must have adequate study, experimentation and demonstration before these improved methods can be generally brought before the notice of numerous cultivators over these wide areas.

Again it can be reiterated that there is no time to be lost in tackling the many problems of these areas of low fertility with thousands of people who are at the best ill-fed and a prey to diseases of which malaria is not the least. It may again be asked if in twenty years time the bulk of the people will not in the normal year suffer from actual starvation and be incapable of real efforts in the improvement of their living conditions on which the status of the soil has the most influence.

ECONOMIC PROGRESS.

Following on this somewhat drear picture of what may happen one may turn to the possibilities of economic progress which as far as one can see means largely the production of commodities for sale. Emigration of a large number of men to South Africa cannot affect the greater bulk of the three hundred thousand odd people. At any rate this problem has been dealt with elsewhere and it may be that in the near future such labour will not be required to the same extent.

Handicrafts such as basket making and weaving need not be considered as several years would elapse before many people would take to them and the industries be of any importance.

The commodities for sale will be fish, meat, animal and agricultural products. The first two will have almost entirely a local sale but those products such as ghee, cheese, oil seeds or even vegetable oils, fibres, leaf tobacco and rubber must all have careful consideration. It is not the purpose here to go into the economics of any of these but two great difficulties in the development of industries dealing with these must be mentioned.

TRANSPORT.

The areas where any of these commodities can be produced have been listed in Parts 1 and 15 and it is necessary to consider first the accessibility of the zones to Lake transport and rail head.

The lowlands of Kota Kota present no difficulty and the rubber industry of Vizara is quite close to Nkata Bay. The cotton industry of North Nyasa is served by several good anchorages and the small production of tobacco in Kota Kota and Kasungu is sold on the Dowa market at Mponela.

The problem of evacuating any commodity from other areas however is one of considerable difficulty unless we except such high priced produce as bright tobacco from Kasungu or ghee from Mzimba. The only exit for the latter which can be said to be economically possible is the Great North Road through Lilongwe to the railway at Salima and for lower priced commodities this is simply not a reasonable proposition.

There are other roads from this hinterland over the high and bleak Vipya range and through the very broken country of West Nyasa and Livingstonia but the anchorages on Lake Nyasa at which these roads terminate are Florence Bay and Nkata Bay which are seventy miles apart. The distance which products from the Akamanga country or the Kasitu valley has to travel rules out the sale of any product whose present price would offer any attraction to the native and whose behaviour in any particular area has been fully investigated.

There may be a possible route which would make things easier. Such a route near the Ruvuo was viewed from the air in a recent tour and is worth investigation.

EUROPEAN SETTLEMENT.

It has been remarked elsewhere that beyond the official, trading and missionary communities there are only three Europeans actually living in the 'dead' north who can be said to be engaged in the small cotton, rice, rubber, coffee, tobacco and animal industries. This is unfortunate because, although the example of inexperienced European settlers in more southerly areas in their treatment of soils, etc., has not been of the best, it is maintained that settlement of the right type of man who would develop various industries would be of incalculable value to the present great problem of the 'dead' north. Such examples have been the rubber industry of Vizara and the cotton and rice industries of the Lake shore.

Of course the present staff of the administrative, agricultural, veterinary and forestry departments are doing valuable work but the present size of this staff in such a large area and with such a large backward population can only bring about results in economic progress after many years.

It may be asked if there is any room for European settlers and the answer can be made in the affirmative. The settler would however under the particular conditions of any area he chose for his activities require much help and technical assistance. It is a pity that restriction of the production of tea rules out areas of West Nyasa but there are chances of successfully growing other crops in such areas and the Department of Agriculture in its advisory capacity would be only too anxious to help.

It has been suggested that officers with special experience should deal with the high priced commodities which at the present time the 'dead' north can only produce. Such a case is the suggestion that a practical sheepfarmer should foster a small stock industry on the Vipya but on the other hand is the opposite view that the agricultural officer has a large experience and the mass of information that such experimental stations as Zomba and Nkwali have accumulated is at his disposal.

It is regretted that the results of this survey should present such a drear picture of the 'dead' north but it shows at any rate that there is a vast field of work and that those who are responsible for the well-being of the native population should allow no time to be lost in framing a policy and programme of activities on the part of the departments concerned which will at least arrest the present rapid denudation and soil degradation.

It will mean a large expenditure which unfortunately at the present time the production of crops or other commodities cannot hope to pay for.

AGRICULTURAL SURVEY.

THE POPULATION OF NORTHERN NYASALAND WITH STATISTICAL DATA.

BY A. J. W. HORNBY, M.B.E., B.Sc., A.I.C.

The writer is indebted for figures of native population to the survey carried out in 1937 by Mr. Eric Smith and his co-workers and it is desired by means of the tables to show that many parts of northern Nyasaland have now reached saturation capacity as far as land of a medium to good fertility at lower elevations below 4,000 ft. is concerned. By this fertility is meant soil which will in the average season give a fair yield of food crops when the usual methods of cultivation by natives are employed. Naturally there are many acres of land outside the village areas at present congested which would, by means of up-to-date methods of small-holders in other parts of the world, give quite a good yield. However it must be understood that many of our native people are averse to carrying out the lengthy tasks from which many millions of Europeans and Asiatic farmers only snatch a little rest during the long summer day. Indeed it will be many decades before any admirable small-holding schemes are in operation over wide areas.

To utilize the figures of the total adult male population in northern Nyasaland, there has been taken as necessary to the production of an adequate amount of food for all persons—five acres to each adult man in North Nyasa and four acres to each man in the other areas.

This is included in the following table.

	Area in square miles	Total population	Total adult male population	Land necessary B x factor as above	Approx total acreage	Approx acreage of land of medium to good fertility outside Forest Reserves
	A	B	C	D		
North Nyasa	... 3,004 ...	46,016 ...	13,425 ...	67,125 ...	1,920,000 ...	248,000
West Nyasa	... 1,925 ...	49,077 ...	16,717 ...	85,868 ...	1,250,000 ...	90,000
Mzimba	... 5,729 ...	150,054 ...	46,316 ...	185,264 ...	3,660,000 ...	350,000
Kota Kota	... 2,431 ...	70,632 ...	23,475 ...	93,900 ...	1,555,000 ...	193,000
Kasungu	... 3,790 ...	27,770 ...	10,644 ...	42,476 ...	2,430,000 ...	171,000

The saturation factor in the above five districts on the above premises works out at 27, 53, 73, 48.6, and 24.8 per cent. It is agreed that in the absence of an accurate survey of all the land concerned these figures are approximate only but the assessment is presented as giving a reasonable picture of the present congestion in certain areas. Furthermore there are the large areas required for the grazing of the herds of all villages outside the fly belts.

Also the figures C and D given refer to the whole district and it must be realized also that some fertile areas are unoccupied, inaccessible, or so subject to depredations of wild animals such as lions, elephant, monkey or pig that settlement is impossible.

Without being unduly alarming attention may be directed to such areas as the Lake shore of part of Kyungu, of Gulu in West Nyasa, Mwamlowe and Mwamkumbira in Mzimba where the population of really good land on a reasonable slope is from 150 to 200 to the square mile.

A table is here given of the population densities (E) of the various sections but also an estimate of the population (F) to the square mile of land of medium to good fertility outside the Forest Reserves and below the high and cold mountain areas and plateaux of the Nyika, the Vipya and Misuku and other highland areas unsuited to native settlement. (These highland areas may be suitable for European settlement).

It is evident on all counts that the situation requires careful watching and more careful assessment.

			Number of villages		Population density (E)	Population density (F)
NORTH NYASA:						
Kyungu and other hill areas	...	...	185	...	3	14
Kyungu and Mwafulira lake shore plain	...	...	140	...	26.4	34.6
Nyondo	...	...	18	} included in above hill areas		
Mwenimisuku	...	...	34			
Kirupula	...	...	46			
Mwenyawenya	...	...	18			
Ntalira	...	...	20			
MZIMBA:						
M'mbelwa	...	...	220	...	45	56
Mtwaro	...	...	400	...	21	39
Chindi	...	...	240	...	42	49
Alifeyu	...	...	170	...	23	35
Yakobe	...	...	160	...	24	36
Pickford	...	...	52	...	30	47
Moses	...	...	90	...	69	81
Mwamlowe and Mwamkumbira	...	...	40	...	18	150
Chikulamayembe	...	...	135	...	10	32
Katumbi	...	...	18	...	6	28
WEST NYASA:						
Kalumu (Malenga)	...	...	50	...	40	190
Gulu	...	...	32	...	78	200
Mankambira	...	...	53	...	54	150
Mkumbira	...	...	47	...	31	90
Mbwana	...	...	27	...	18	62
Kabanduli	...	...	55	...	11	38
KOTA KOTA:						
Kanyenda	...	...	50	...	14	35
Msusa	...	...	140	...	17	60
Mwadzama	...	...	83	...	37	92
Kasakula	...	...	56	...	77	125
Jere	...	...	97	...	129	210
Nthondo	...	...	61	...	88	170
Kalumo	...	...	136	...	38	90
KASUNGU:						
Mwase and Chulu	...	...	240	...	11	35
Santhe	...	...	20	...	3.1	10
Kaluluma	...	...	83	...	16.3	52

NOTE. Likoma and Chisumula Islands have not been taken into consideration in the above figures.

Various matters relating to separate native tribes under 10 comprehensive heads have been well described in the Census Report of 1926 and in the Handbook of Nyasaland by Mr. S. S. Murray, M.B.E., and need not be dealt with here.

The following tribes, adopting his nomenclature, are found in northern Nyasaland in greatest number as follows:

- The Nyanja Tribe in Kota Kota and North Nyasa
- The Chewa-Chipeta in Kasungu, Kota Kota and Mzimba
- The Ngoni in Mzimba, Kasungu and Kota Kota
- The Yao in small numbers in all but West Nyasa
- The Tumbuka in Mzimba
- The Tonga in West Nyasa
- The Nkonde in North Nyasa

The approximate number of these tribes in northern Nyasaland is as follows :

Nyanja	...	...	...	2,000
Chewa-Chipeta		...	...	83,000
Ngoni	...	...	...	115,000
Yao	...	...	...	2,200
Tumbuka	...	...	...	46,000
Tonga	...	...	...	49,000
Nkonde	...	...	...	46,000

The total population according to the Blue Book of 1937 is 343,549 consisting of 151,752 native males, 191,561 native females, 101 Europeans and 31 Asiatics.

It seems that, of the persons of European origin, only six were employed in agriculture, of which the Agricultural Department accounted for three and the cotton and rubber industry for the other three.

AGRICULTURAL SURVEY.

SOIL AND VEGETATION DATA WITH SOIL ANALYSES AND GLOSSARY OF GRASSES

BY A. J. W. HORNBY AND J. E. L. FENNER.

It will be noted that in all parts of northern Nyasaland there is a large destruction of tree growth. The several causes are the annual bush fires, the clearing and burning for new gardens, the use of poles and tying material for houses, use for the household and for fences against wild beasts. The curing of dark-fired tobacco produced in southern Kasungu and west Kota Kota also requires the use of hard woods but it has been computed by supervisors of the Native Tobacco Board that the quantity of timber used in this industry does not amount to one per cent. of the total annual destruction mentioned above.

There are changes going on in the vegetation of all northern Nyasaland and only in the tall bunch-grass savanna with grass of the climax type on such areas as the Vipya and Nyika, in marsh grassland or in the few areas of moist deciduous and upper montane rain forest is there no appreciable change over several decades. Even in these forests and in mountain grasslands however human agency is at its work of destruction at the fringes.

It is not the purpose of this appendix to examine exhaustively all the vegetation and soil data which have been collected because an early report was called for and time precludes an adequate study of the ecology with physical and chemical examination of the numerous soil types. The results of such work can be made the subject of a further bulletin and it is thought necessary here only to give a general sketch of the vegetation types from information derived from the various full reports and a short description of the various soil types with some chemical data.

At any rate a classification of the different types of savanna woodland found on soils varying from the poor sandy and gravelly types to those on the hard sandy clays with greatly varying slopes interspersed with many local soils can at this stage be of little use to the survey. Officers who have reported the prevalence and extent of open woodland, orchard country and high grass savannah with palm stands have been indebted to various publications which are referred to in the context. It has been impossible however for all of them to distinguish where the transition from one dry forest type to another may be said to occur. The most prevalent type covering large areas of the sandy soils and red sandy clays are *Brachystegia*—*Isoberlinia* open woodlands. In the Kasungu-Mzimba undulating uplands, the type most largely includes *Brachystegia boehmii* with *Isoberlinia globifera* and *I. paniculata*, but the latter often occurs in small areas with few other species. These areas are usually on poorer acid intrazonal soils with characteristic incrustations of iron and alumina compounds formed under particular local conditions.

On other soils the *Brachystegia* species become associated to a greater extent with *Uapaca* and *Diplorrhynchus* species.

A special association of large *Brachystegia* trees with *Burkea africana*, *Uapaca nitida*, etc., is found on the sandy soils west of the Mbiri ridge above Deep Bay. Here we have an example of a superior woodland on inferior soils and it is feared that, if such woodland is cleared for native agriculture, headlong destruction of fertility would result similar to that experienced on the Orangeburg soils of the Southern States. It is considered that such areas should only be touched by native cultivation under careful supervision, in well laid out strips provided with ridge terraces, cover crops and contour hedges.

To give an example of the variation of tree flora on fairly flat land in close proximity on the western plateau of Lilongwe-Kasungu the following determinations close to places where the soil profile was carefully examined by deep pits are given :

Soil	Vegetation (Specific names also in check list of Forest Trees by Mr. P. Topham).
No. 1. Likuni hard red sandy loam with grav- elly subsoil, humic layer to 8 inches	muanga <i>Afrormosia</i> sp. nalitenjere <i>Combretum mechowianum</i> kakunguni „ sp. mkute „ „ msopa <i>Bridelia</i> sp. mtete <i>Acacia campylacantha</i> napini <i>Terminalia sericea</i> small trees: mteme, mkwatamo, nchiu kangu- ntondo, mziru, kabzero. Thatching grass 6 to 12 feet.
No. 2. Mtsilo grey sandy soil with light grey sandy subsoil, humic layer to 11 inches	mteme <i>Strychnos</i> sp. small trees: mtete, msewa coppice, nswanswa, chitimbe, msiroti, mziru with medium thatch- ing grass.
No. 3. Likuni hard grey sandy soil with hard yellow subsoil, humic layer to seven inches	ntondo (numerous) <i>Isoberlinia paniculata</i> ntantanyerere coppice kakunguni „ chikumansi, nandolo, nkulo
No. 4. Likuni reddish fine gravelly loam with bright red coarse sandy clay subsoil, humic layer to 12 inches	small trees: mteme, kangande, mkute, bwabwa chitimbe, kalama ngwanjazi, napini medium thatching grass.
No. 5. Likuni hard brown sandy soil with friable red sandy subsoil, humic layer to 12 inches.	mwanga savannah: <i>Afrormosia angolensis</i> Dense coppice of mpando with individual kachi- ndakalulu and ntunda. small <i>Protea</i> . Dense and tall thatching grass 7 to 12 feet high.

To cut a long story short it has been found necessary to combine together the *Brachystegia-Isoberlinia-Uapaca* types which cover so much land of no present value for agriculture. Of other types of savannah woodland the *Acacia-Combretum-Bauhinia*—of the more fertile northern areas of Mzimba and North Nyasa and the foot-hill type of *Sterculia-Diospyros-Terminalia* are of importance.

The small areas of tropical upper montane rain forest and conifer forest in North Nyasa need not again be referred to.

The types of vegetation on the lowlands of the agricultural divisions may now be dealt with. The most important of these is the association on drier alluvium such as that of the Kota Kota cotton belt and of Vua. The most prominent trees are large nsangu, *Acacia albidia*, which are often left standing near villages for shade. With congested areas of native cultivation are associated the sausage tree, *Kigelia aethiopica*, Baobab, *Adansonia digitata* and *Trichilia emetica*.

To the west of these areas and indeed running in long narrow bands between the fertile Lake littoral and the poor *Brachystegia* country is the savannah thorn land with numerous *Combretum* and *Acacia* on fairly fertile land.

In the wetter lowland areas, there are palm swamps, stands of *Hyphaene* on the Lake Shore and inland in valleys *Phoenix* and *Raphia* palm. Again in the wetter areas of West Nyasa, the oil palm, *Elaeis*, grows wild and this may eventually be utilized as a source of oil very valuable in native diet.

The several types of grassland can now be considered. The Vipya climax grassland itself could be divided into tall bunch-grass savanna which covers at least 100,000 acres and into patna country which is found on acid light reddish soils which have been considerably leached under the higher rainfall. Again at lower elevations with lower rainfall the denuded country is covered with the low bunch-grass savanna. The *Acacia* tall grass savanna described by Shantz occurs in many lowland areas.

There is much work to be done on all the grassland formations but such good fodder grasses as *Pennisetum purpureum*, *Panicum maximum* and *Setaria* species in the high grass savanna covering very large areas should be made use of in the eventual establishment of a cattle industry outside the tsetse belts.

The Nyika plateau is also covered with similar grasslands to that of the Vipya and the better types cover at least 200,000 acres. This does not mean that somewhat inferior grassland on these high plateaux cannot be utilized for alternative grazing.

In view of the backward state of the live-stock industries little more need be said concerning grassland formations found in the various agricultural divisions. The high grass tropical savanna covers very large areas in the sheltered parts of the highlands and in cleared and abandoned lowland areas where savanna thornland was once dominant.

On the best alluvial soils the *Paspalum*—*Brachiaria*—finer *Hyparrhenia* species predominate. On the sandy plains in lowland areas and better valley soils of Mzimba, various forms are found such as associations of *Heteropogon contortus*, *Eragrostis major*, *Tristachya* sp., and *Panicum maximum*. The grassland of dambos are very variable with the great difference in soil texture, in dampness depending on the drainage, slope and type of soil on swells surrounding the valley.

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Glossary of grasses of northern Nyasaland included at end of this Appendix.

SOILS.

It was hoped to include a soil map with this publication but it is unfortunate that the basal maps prepared and sent for publication a year ago are not yet to hand. As soon as these are received the distribution of soils and populations will be shown by superimposing colours, etc., such information being of value to the administration and agricultural activities in the various districts and sections.

The classification which has been adopted in the several zones of northern Nyasaland follows the system adopted by the United States Bureau of Soils. To quote Emerson in Principles of Soil Technology:—

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“The classification of soil as adopted by the United States Bureau of Soils is in reality an adaptation and combination of those features of previous classification which have been found to apply to the characteristic features of the soils (in situ) of the entire United States. It recognizes the geological, physical, chemical, and genetic characteristics of the soil profile. The United States Bureau of Soils classifies areas on the basis of (1) the soil region or the soil province; (2) the soil series; (3) the soil class; and (4) the soil type. The unit of classification is the type. The type name consists of two or more words. The first word is the series name; the second is class name (Webster loam). When there are more than two words, the additional words are explanatory and may be in relation to texture (Susquehanna fine sandy loam), or in relation to certain physiographic characteristics (Tama loam, rolling phase), etc. The series is a characteristic of, and the name is used only in, a certain region or province. The class is characteristic of all areas. A certain type can only occur in a certain region or province. It is not limited to a definite and continuous area but may occur in many isolated areas, distributed over a larger division. Naming the Type.—Naming or designating a soil type is a painstaking operation and is the result of a careful study and correlation of many characteristic profiles over an extended area. The type is named as a result of cooperative field and laboratory work, and correlated by competent individuals. The field work is done by the soil surveyor who takes a census of the soil characteristics of the area. He notes in general the formation and origin of the soil, its topographic and geographic features, its drainage system and its agricultural relationships. He studies in detail the structure, texture, and consistence of the soil profile, taking careful notes of color changes, physical composition, and other details that may become important. The laboratory work consists of mechanical and chemical analyses. The mechanical analyses are used mainly as a basis for the class separation, the chemical being used as an indication of the agricultural value, origin, formation, etc. The field and laboratory results are correlated by inspectors from the Bureau of Soils, aided by the surveyor and possibly others. Thus by cooperation, the characteristics and limitations of the type are defined and described in such a manner that, as far as possible, the type will be recognizable—at least by competent individuals, when again encountered in the field. While it is a comparatively simple matter to define the characteristic type of a certain area, the differentiation of closely related types and the allocation of the border line becomes extremely difficult.”

Soil series as listed below have been recognised in the various agricultural divisions. The climate under which they have been formed is described in Part 1 and in this appendix only brief notes of these soils is thought necessary. Examples of types are given.

<i>Soil series</i>	<i>Types</i>
Ahenga	light sandy to medium brown loams
Chimvua	sands to grey sandy loams
Hara	sands to sandy clays
Karonga	alluvial sandy loams
Kasungu-dambo	grey-white fine sandy to peaty soils
Kasungu	grey sands to coarse sandy soils
Likuni	numerous red soils in higher plateaux
Mtsilo	grey sands to dark grey loams
Mzimba	shallow red sandy soils
Nsanga	sandy clays, etc.
Nyika-escarpment	gravels to hard clay loams
Vipya	acid reddish clay loams
Vua	alluvial grey loams

Brief notes on these soils and some analyses are included in this appendix.

NOTES ON SOIL SERIES AND Types (J. E. L. F.)

THE SOUTHERN KASUNGU AREA AND MAIN KASUNGU PLAIN.

Kasungu coarse sandy red-brown soils. These form the predominant soil type of the zone and have little to commend them. They possess a very poor humic content and rest on a sandy subsoil varying in colour from yellowish-grey to red. While many of them are under cultivation they invariably give poor yields and react unfavourably to any seasonal irregularities. Their population is, of necessity, a shifting one and carries out a shifting type of agriculture.

Kasungu grey to yellow-red sandy soils. These occur in the western portion of the Southern Kasungu area and, to some extent in the central section south of Kasungu boma. They are of moderate fertility and contain more organic matter than the preceding types. They are however, mainly adjacent to the Fort Alston game reserve and crops grown on them suffer much damage from elephant and other game.

Likuni red to chocolate coloured loams. These occur in patches of varying sizes all over the Southern Kasungu area and the southern extremity of the main Kasungu plain. They are, relatively deep soils overlying fairly friable red-brown subsoils and possessing a high humic content. They carry a superior mantle of vegetation and, with the small alluvial areas, represent the most fertile soil types in the zone.

Kasungu-dambo. The area covered by dambos in this zone is considerable. They vary from grey-white fine clay sands to the peaty soils of the Bua and the Rusa rivers and include the little-cracking darker clays.

Chimvua grey-white to yellow-buff clay sands are mainly sour soils unfitted to cultivation and are commonest north of the Dwangwa river. The little-cracking grey to grey-black clays are more or less confined to that country lying south of the Dwangwa river where they are of great importance to the population living on the coarse sandy soils. Peaty types are met with only in the vicinity of the Bua and Rusa rivers.

Likuni friable dark loam to about 18" overlying heavy dark clay subsoil. This type covers too small an area to be of any economic importance.

Mzimba shallow red soils. There are to be found in broken country in the central area of the main Kasungu plain and also along its eastern border.

The following types are also present but need not be described at length.

Escarpment gravels and sandy clays.

Gravelly drift and concretionary material.

THE HIGHLANDS OF SOUTHERN MZIMBA AND NORTHERN KASUNGU.

Likuni friable dark loams. These types cover almost 50% of the zone. Starting just south of the Chimaliro forest reserve, they continue in a north easterly direction to the southern limits

of the Perekezi forest reserve. They average a depth of some 18", are medium to light textured and overlie a heavy clay subsoil. They may vary in colour from a light red-brown to a deep red but the subsoil is invariably red. They have a good humic content and can be made highly productive.

Likuni light sandy loams. These types form a compact block in the central portion of the zone. They range from whitish-red to red-brown with a comparatively high proportion of fine sand but are somewhat deficient in humus. They have been subject to continuous cultivation for many years and the greater part of the area they occupy has a population density of nearly 70 per square mile. In spite of this fact and their badly overworked condition they still continue to give moderately good returns.

Mzimba shallow red soils. These will be discussed in the soil classes of the Akamanga and South Rukuru plain. They cover areas in the north and west of this zone which are extensions of the belt in the southern portion of the South Rukuru plain. They also occur as a band separating the good red soils of the east from the coarse sands of the extreme southern central area.

Kasungu grey to yellow-red sandy soils. The area covered by these is not extensive and consists of isolated patches scattered over the zone, the largest being adjacent to the Loudon Mission Station below the western extremity of the Perekezi forest reserve.

Good red soils. These extend over a section of broken, well-wooded country bordered by escarpment gravels in the extreme limit of the zone. They will be further described in the soil classes of the eastern Vipya, Limpasa, Konga areas.

Dambos. In this zone dambo types are principally of the more fertile little-cracking darker clays. A few sour grey-white fine clay sands are met with, mainly in flood areas adjacent to the grey to yellow-red sandy soil patches.

THE AKAMANGA AND SOUTH RUKURU PLAINS.

Mzimba shallow red soils. These form an extensive group and occur over large tracts of generally broken country. As their name implies they are shallow, and vary in colour from greyish red to red-brown, having a very low humic content. They may be said to resemble the granite sands of the Salisbury and Fort Jameson plateaux. They are traversed by numerous outcrops of escarpment gravels, are of low productivity, and can be divided into three main areas.

- (a) The entire southern portion of the South Rukuru plain extending to the West Nyasa boundary and the southern foothills of the Vipya in the west and north-west.
- (b) The central area of the South Rukuru plain.
- (c) The western section of the Akamanga plain. These soils carry poor and erratic maize crops and are generally in an overworked and exhausted condition.

Ahenga light sandy loams. These are mainly light, friable soils covering the eastern portion of the Akamanga plain and running in a narrow band up the South Rukuru river. They range from a greyish-brown to a brownish-red in colour, are well-drained, and of good fertility.

Sandy soils. These ubiquitous and generally unproductive types are widely scattered over the zone. A large proportion of them approximate to the older ironstone soils of north western Rhodesia and the following description taken from a recent report applies equally well to these similar Nyasaland types:

"These are shallow pallid soils of clayey to sandy texture, loaded with ferruginous nodules and fringed with massive concretionary ironstone. These "fossil" soils are exemplified on the Lisaka limestones, but are best preserved along the Congo border and towards the Lukanga swamp. They vary little with geological formation and answer to the class of Murram soils on the East African Soil Map. Except that they are employed by natives for finger millet cultivation, they are agriculturally useless.

(The soils, vegetation and agricultural systems of North Western Rhodesia. 1937)

Likuni medium red loams. These are represented by a narrow belt on the Northern Rhodesian border and by a small patch adjacent to the southern extremity of the Vipya escarpment known locally as the Vipya maize lands. In most cases they possess a uniform deep red colour but may be overlain by a pale red surface horizon. While they contain some of the most fertile types in the zone the situation on the watershed on the Northern Rhodesian border has so far precluded any extensive utilization by natives, the water table being too low to be reached by native waterholes.

Red and brown lateritic soils. These form strips traversing the Ahenga light sandy loams in the northern portion of the South Rukuru plain. They also line the western escarpment of the Vipya highlands and are usually characterised by the poverty of the vegetation. The soils are often gravelly and otherwise hard and compact. They are agriculturally useless in this area.

Alluvium. There are only two patches of true alluvium in the zone, one south of the Inderenderi marsh and the other lying to the north of Mparai hill. They are both silt loams of river sides and vary in colour from grey-brown to black. They carry acacia-dry grassland and provide excellent maize land.

Dambos. These have been dealt with in detail in the soil classes above and it will be sufficient to remark here that the area covered by them in this zone is considerable. Generally speaking, grey silty clays of a non-cracking type are confined to the east, while the South Rukuru and other dimba areas of the west are mainly composed of little-cracking blacker clays, which provide good grazing and areas well suited to cultivation.

The following data lately forwarded by the Agricultural Officer, North Nyasa, shows the large proportion of infertile soils in the northern portion of the Mzimba district.

The total areas of the various zones have been divided as under :

- (a) Land formerly cultivated but now abandoned.
- (b) Land now under cultivation.
- (c) Land not yet under but capable of cultivation.
- (d) Infertile land.

It should be emphasised that between (a) and (c) there is but little difference. Land appears never to be abandoned but is merely left fallow, perhaps for twenty years, and it is rare to find land of any value that has not been cultivated sometime or other and has been left for a while to recuperate.

Upper Henga Valley (Mzinga, Kondowe, Nkaramteta area)

- | | |
|---------------------|---------------------|
| (a) nil | (c) 10 square miles |
| (b) 45 square miles | (d) 95 " " |

Lower Henga Valley (Ngonga area)

- | | |
|---------------------|---------------------|
| (a) 10 square miles | (c) 10 square miles |
| (b) 20 " " | (d) 20 " " |

Nkamanga Plain.

- | | |
|----------------------|---------------------|
| (a) 20 square miles. | (c) 20 square miles |
| (b) 100 " " | (d) 100 " " |

Hewe Valley.

- | | |
|----------------------|---------------------|
| (a) nil. | (c) 10 square miles |
| (b) 20 square miles. | (d) 70 " " |

Luwewe Area.

- | | |
|---------------------|--------------------|
| (a) 10 square miles | (c) 5 square miles |
| (b) 10 " " | (d) 275 " " |

In addition there are a few villages scattered round the edge of the Nyika Plateau at an approximate altitude of 6,000 ft. They practise a form of shifting cultivation or long-term fallow and their total area under cultivation is probably not more than 10 square miles.

DESCRIPTION OF TYPICAL PROFILES.

MZIMBA DISTRICT, KASITU VALLEY.

SOIL PROFILE No. 1.

SOIL TYPE. That described in survey reports as Kasungu series; better valley sandy type.

LOCALITY. Found all over that area adjacent to and in the Kasitu valley. The type is all under cultivation and has been for a considerable period.

VEGETATION is listed under better valley soils.

GENERAL DESCRIPTION. The top soil varies from red-brown to a lighter red. Humic mat is usually absent due to the fact that the type is extensively cultivated. Differences between sub-soil horizons are barely perceptible excepting for an increased tendency to coarseness of grain with depth.

A horizon of quartz pebbles occurs at a depth of 10ft. 3 inches. Nineteen inches below this horizon the sub-soil ends and merges into decomposed rock. The upper horizons of the latter vary between putty colour and whitish red and contain a large amount of mica.

From 17' 9", downward, the profile presents a single decomposed granite face with veins of felspar and horizons of quartz traversing it.

Partially decomposed rock is reached at 29' 8", and continues to 31' 2".

Depths of Individual Samples.

			Inches.	
A.	Surface Humic mat	...	—	Absent.
B.	Humic soil	...	1.5	Brownish-red, single grain, Large % of small quartz particles in form of fine sand. Colour slightly more red.
C.	" "	...	1.5	
D.	" "	...	3.5	
E.	Sub humic	...	9	Redder than above.
F1.	" "	...	9	Hard.
F2.	" "	...	9.5	
G1.	Sub soil	...	10	Pronounced single grain structure. More compact than F. Lighter colour.
G2.	" "	...	11	
H1.	" "	...	17	Coarse structure containing large grains of quartz. Much mica.
H2.	" "	...	17	
H3.	" "	...	17	
H4.	" "	...	17	
I.	Quartz horizon	...	4	Pebbles up to 3" in diameter.
J.	"	...	19	Similar to H.
K1.	Sub soil	...	19	Sub soil merging into decomposed rock. Whitish red.
K2.	" "	...	19	
L1.	" "	...	9	Putty coloured. Large amount of mica.
L2.	Decomposed rock	...	10	
L3.	" "	...	10	
M1.	" "	...	9	From M down rock strata clearly defined.
M2.	" "	...	9	
N1.	" "	...	7	Mottled, granitelike, veined with felspar.
N2.	" "	...	6	
O1.	" "	...	12	Occasional pieces of partially decomposed quartz
O2.	" "	...	12	
O3.	" "	...	12	
P.	" "	...	4	Vein in stratum.
Q1.	" "	...	7.5	Somewhat harder than O or R.
Q2.	" "	...	7.5	
R1.	" "	...	10.5	Similar to O.
R2.	" "	...	10.5	
T1.	" "	...	6	Grey, powdery, granitelike.
T2.	" "	...	6	
T3.	Decomposed rock	...	6	
T4.	" "	...	6	
T5.	" "	...	6	
T6.	" "	...	6	
U1.	Partially decomposed rock	...	6	Decomposition appears to be just beginning.
U2.	" "	...	12	

Total depth 31 feet 2 inches

* Biotite gneiss veined by quartz.

SOIL PROFILE No 2.

SOIL TYPE. Kasungu sandy soil, the sand overlying a red, gravelly hard pan, and its presence being denoted by stands of *Brachystegia mimosifolia* in association with *Landolphia kirkii*.

LOCALITY somewhat local in its occurrence in this area and is more or less confined to three regions:—

(a) The rough quadrilateral formed by the Kasitu river, the Lunyangwa, and the main Mzimba Ekwendeni road from the Kasitu bridge to the Lunyangwa bridge thereon.

(b) A strip of varying width on both sides of the main Mzimba/Ekwendeni road, from the junction of the Njakwa short cut with that road, to Ekwendeni mission.

(c) North of the main Mzimba/Ekwendeni/Nkata road and south of the old, disused road, from Ekwendeni mission up to Changafwa hill.

VEGETATION is listed under excessively sandy, shallow soils in separate vegetation lists.

GENERAL DESCRIPTION. This soil type is only found on gentle slopes and does not occur in or near the actual valley-lines. The top soil may be in one of two forms: (a) Coarse grained red or whitish-red sand, or (b) Hard reddish-brown or deep red soil. The humic mat is invariably absent, even in the *B. mimosifolia* and *L. kirkii* thickets. In the latter instance this is due to the annual fires. The top soil is particularly shallow and 8" appears to be its maximum depth when present. In other places the surface layer of coarse sand is slightly deeper. The sub-humic layer also appears to be extremely shallow and contains a large quantity of stone particles.

The whole profile presents a smooth, hard face from top to bottom. Up to 19ft. the colour profile is fairly uniform and of a deep red colour. Below 19ft. the shade gradually lightens until, at 34ft. it changes to a mixture of tints with shades of grey predominant. At 37ft. 6 inches operations were discontinued. At this point the base of the profile pit resembles a coarse-sand stream bed strewn with pebbles and small boulders.

From the top of the horizon of quartz stones, found just below the sub-humic layer, to the top of the stone horizon (0), 29ft below, varying degrees of hardness were almost the only distinguishing features and no horizons composed entirely of decomposed rock could be distinguished. Immediately below horizon 0 several large quartz boulders were found.

Depths of Individual Samples.

			Inches.	
—	Surface humic mat	...	—	Absent.
A1.	Humic soil	...	1.5	Brownish-red with large proportion of coarse sand particles and mass of thin surface roots.
A2.	" "	...	1.5	
B1.	Sub humic	...	5	Harder than A.
B2.	" "	...	6	Lateritic appearance with large, coarse grains.
C.	Quartz horizon	...	12	Quartzstones up to 5" in diameter, in dark red-brown soil. The limit of all roots excepting those of <i>B. mimosifolia</i> .
D1.	Sub soil	...	9	Somewhat lighter in colour with small pebbles but no large stones.
D2.	" "	...	9	
E.	" "	...	9	Lighter than D. with large amount of broken quartz. Limit of <i>B. mimosifolia</i> roots.
F1.	" "	...	9	Dark red. Appears to be less crushed quartz.
F2.	" "	...	9	
G1.	" "	...	14	Similar to E.
G2.	" "	...	14	Variety of crushed stones.
H1.	" "	...	11	Harder than the above but of similar colour.
H2.	" "	...	11	
I1.	" "	...	10	As hard as H. but a slightly lighter red and more plentifully flecked with white.
I2.	" "	...	10	
I3.	" "	...	10	
J1.	" "	...	15	Somewhat softer and more sandy than the above.
J2.	" "	...	15	
J3.	" "	...	14	
K1.	" "	...	16	Harder and even more compact.
K2.	" "	...	16	
L1.	" "	...	15	Colour of profile now much lighter, having a white, powdery appearance. Very hard.
L2.	" "	...	15	
L3.	" "	...	14	

Depths of Individual Samples.

				Inches.		
M1.	"	"	...	...	14	Lighter coloured than L with some decomposed rock.
M2.	"	"	...	...	13	Extremely hard. Grey streaks running through the red.
M3.	"	"	...	...	13	
M4.	"	"	...	...	13	
M5.	"	"	...	...	13	
N1.	"	"	...	...	13	Light red. Very much softer.
N2.	"	"	...	...	13	Sandy yet compact.
O.	Stone Horizon		...	...	12	Quartz and other pebbles up to 8" in diameter with small boulders protruding from 'P'.
P.	Horizon of small pebbles with some boulders		...	...	9	Some decomposed rock mixed with the pebbles surrounding the boulders.
Q1.	Coarse-grained sand		...	...	11	Light brownish red in the main, but formed of a variety of broken rocks
Q2.	...		...	...	11	
Q3.	...		...	...	10	
R1.	'Stream bed' formation			...	13	Some decomposed rock, mixed with sand, pebbles and larger, undecomposed stones.
R2.	...		...	...	13	
R3.	...		...	...	8	
S.	Samples of types of rock from floor of pit. Alluvial wash. Pebbles of quartz, with less abundant pebbles of pegmatite, granitic rock and gneisses.					

Total depth 37 feet 6 inches.

SOIL PROFILE No. 3.

SOIL TYPE. That described in previous reports as light, grey alluvium. (Chimvua series).

LOCALITY. This type is comparatively rare in the eastern and southern portions of the valleys and is confined to small strips and patches adjacent to some of the larger dambos. In the west and north-west, however, it is more frequent and is to be found between stretches of heavier alluvium along the Rukuru and the lower reaches of the Kasitu river.

VEGETATION. As all this type is under cultivation it is impossible to give a complete list, but from the few trees left standing *Kigelia* sp. (Mvunguti) and *Ficus* sp. would appear to be very common. *Combretum splendens* is also to be found.

GENERAL DESCRIPTION. The top soil varies in colour between a dark grey and a grey-black. A humic mat would almost certainly be present were any of this type uncultivated, and on patches in gardens that have been left untouched for one season a thick mat of fibrous roots is formed just below the surface.

The subsoil is, generally, of a red colour with a good clay content. A very light grey horizon, however, runs through the red soil and consists of a much sandier type having little or no tenacity.

Decomposed rock begins at a depth of about 12ft., and continues to a depth of 34ft. 6 inches. The maximum depth of root penetration appears to be in the neighbourhood of 12ft., which is some 19" into the decomposed rock.

The water table was found at 23ft.

Depth of Individual Samples.

		Inches.	
—	Surface humic mat	...	Absent.
A1.	Humic layer	1.5	Dark grey, compact-fairly fine grained but with a proportion of coarser particles.
A2.	" " ...	2.5	
B1.	Sub-humic ...	3	Dark grey with fewer coarse grains.
B2.	" " ...	8	
C1.	Sub soil	8	Lighter in colour than above. Hard, plastic, with few large rock particles.
C2.	" " ...	8	
C3.	" " ...	9	
D1.	" " ...	6	Very light grey. Sandy, with little tenacity.
D2.	" " ...	7	

Depth of Individual Samples.

Inches.					
E1.	"	"	...	12	Light red-brown.
E2.	"	"	...	13	Average clay content.
F1.	"	"	...	12	Colour as E. but more compact.
F2.	"	"	...	9	
G1.	"	"	...	14	Colour as above.
G2.	"	"	...	14	Excessively hard, gravelly, with much broken quartz and a fair clay content.
G3.	"	"	...	16	
H1.	Decomposed rock			16	Greenish tinge over profile. Shale-like structure.
H2.	"	"	...	16	Very soft and light, producing a woody sound when cut into.
H3.	"	"	...	16	
H4.	"	"	...	16	
H5.	"	"	...	14	
I1.	"	"	...	14	Some undecomposed quartz mixed with the decomposed material.
I2.	"	"	...	14	
I3.	"	"	...	14	
I4.	"	"	...	13	

WATER TABLE.

J1.	Decomposed rock			14	All below water table and saturated.
J2.	"	"	...	14	
J3.	"	"	...	14	Dries out to a light whiteish-grey.
J4.	"	"	...	14	
J5.	"	"	...	14	
J6.	"	"	...	14	
J7.	"	"	...	14	
J8.	"	"	...	14	
J9.	"	"	...	14	
J10.	"	"	...	12	

Parent rock: Biotite quartz felspar schist.

Total depth 34 feet 6 inches.

SOIL PROFILE No. 4.

SOIL TYPE. That described as Kasungu poorer valley sand.

LOCALITY. Types such as this are common all over the area and are more frequent and universal than the better valley sands. They are seldom cultivated, but are occasionally used for one season for finger millet, owing to their scrub growth. They appear to give an exceedingly poor return and are always abandoned after one crop. The growing of finger millet on such soil is a thriftless habit that does incalculable harm to the vegetation for a minimum return.

VEGETATION is that listed under poorer valley soils in separate vegetation lists.

GENERAL DESCRIPTION. These soil types can always be distinguished from other valley types by their almost white colour and coarse sandy top soil. This differs from the sandy top soil that is sometimes present in types such as Profile No 2., the latter being invariably of a reddish hue.

There is little difference in the colour profile until, at or, 4 ft. 6", the laterite is reached, but there is a general and gradual shading from a light whitish-grey to a darker grey with increasing depth. On two sides of the profile pit parent rock was reached at some 18 ft. It sloped sharply downward, however, and only at 22 ft. 10" was a rock floor found.

The horizon immediately below the laterite, and between it and the pure decomposed rock appeared to be heavy and was exceedingly hard to work through, picks being necessary. The remainder of the subsoil was very like the top soil and almost pure sand. The maximum depth of root penetration was 4 ft. 6", or to the top of the lateritic deposits. The humic mat, although present, appeared very poor.

Termite nests are absent in these soils and the large, hill-forming termite never encroaches on them. Small termites are to be found, but their nests are invariably situated in adjacent strips of other types.

Depths of Individual Samples.

Inches					
A	Surface humic mat			1	
B1.	Top soils	...	...	1.5	Almost pure sand, very light grey when dry and having a slightly reddish tinge when wet.
B2.	"	"	...	2	

Depths of Individual Samples.

		Inches.	
C1.	Sub humic ...	6	As above and indistinguishable from it,
C2.	" " ...	7	
D1.	Sub soil ...	12	Slightly darker in the profile but with no other distinguishing feature.
D2.	" " ...	12	
D3.	" " ...	13	
E1.	Lateritic hard pan ...	12	Some broken quartz and a little soil mixed with the laterite.
E2.	" " " ...	12	
E3.	" " " ...	11	
E4.	" " " ...	11	
F1.	" " " ...	12	As above.
F2.	" " " ...	12	
F3.	" " " ...	12	
F4.	" " " ...	11	
G.	" " " ...	12	
H.	Sub soil ...	13	Heavy grey soil mixed with much broken quartz.
I1.	" " ...	9	Heavy, compact, grey, with few quartz particles and merging into decomposed rock.
I2.	" " ...	10	
J1.	Decomposed rock ...	12	Soft, grey, granite like.
J2.	" " ...	12	
J3.	" " ...	12	
J4.	" " ...	12	
J5.	" " ...	12	
J6.	" " ...	11	
K.	Parent rock, granite		

SOIL PROFILE No. 5. LOW ELEVATION BLACK LOAM, ELEVATION 2,100 FT.

On slight ridges and elevations in the flat areas and has small distribution in Northern Nyasaland.

	Depth in inches.	
1.	0—1.5	Surface humic mat
2.	1.5—3	Layer with organic matter, Rapid change to chololate loam at 3".
3.	3—6	Chololate loam compact and hard in profile: stained with some organic matter.
4.	6—12	Similar to 3, but colour becoming lighter.
5.	12—21	Similar to 4, but lighter and redder in colour, of granular structure.
6.	21—27	Transition to heavier type of soil.
7.	27—39	Clayey soil; reddish yellow with scattered concretions of iron and alumina compounds.
8.	39—51	Clayey soil; with grey and yellow mottlings and a few scattered concretions of iron and other compounds.
9.	51—63	Similar to 8.
10.	63—75	Similar to 8.
11.	76—87	Heavy cinnamon coloured clay. No concretions.

SOIL PROFILE No. 6. TROPICAL CHERNOZEMS IN LAKE LITTORAL, ELEVATION 2,009, COMMON IN KOTA KOTA AND DOWA LOWLANDS AND FOUND NEAR VUA.

	Depth in inches.	
1.	0—2	Surface humic mat, very friable and loose when dry.
2.	2—6	Humic soil
3.	6—15	Transition layer with increasing columnar structure and clay content. Some organic matter.
4.	15—27	Very uniform dark brown soil, columnar cracking very marked.
5.	27—39	" " "
6.	39—51	" " "
7.	51—60	" " "
		All very friable when moist but sticky and plastic when wet.
8.	60—71	Very similar to No. 4, but with scattered limestone concretion, and with cracks diminishing in number and size.
9.	71—80	Limestone concretions diminishing. Soil contains large gravel content, apparently of rotten rock fragments.

From the point of view of native cultivation the dark loam here described is of a heavy and intractable nature. By very expensive methods of drainage and cultivation such soils can be made friable enough to produce good crops of cotton and groundnuts in the average season as has been shown on the Nkwali station. Native cultivators generally do not like these soils on account of the hard work involved but doubtless as time goes on they will be forced to utilize them. It is hoped that they do not destroy a great deal of vegetation in attempts to improve the texture of these soils by fire.

CHEMICAL DATA.

REPORT ON AHENGA VALLEY COFFEE SOIL BY THE MINERAL RESOURCES DEPARTMENT, IMPERIAL INSTITUTE.

AIR DRY FINE EARTH FORWARDED ON NOV. 21, 1931. NUMBERED 1185-1200.

(a) Mineral contents of sand grade, 2 mm—.02 mm. in diam.

The predominant minerals in this group are quartz, which is often heavily iron-stained, and altered golden chloritic material which becomes more abundant at greater depth. The heavy residue, which is very small throughout this series, consist of magnetite, ilmenite, augite, sillimanite, zircon and green chlorite. This assemblage is consistent with the soil being a residual soil derived from the parent rock accompanying this series.

The parent rock consists essentially of orthoclase and an altered felspar (probably microcline) quartz and green chlorite, with a little zircon. It is a coarse-grained rock of gneissic appearance but is altered and very friable and much of the felspar is so kaolinised as to be indeterminable.

It will be observed that an altered golden chlorite material is a very abundant constituent of some soil samples from Nyasaland. It is a mineral whose precise determination is extremely difficult and may be an alteration product of biotite mica or a chlorite in which the iron has become oxidized to a ferric condition.

(b) The soils were mainly of a loam character, ranging in colour from reddish brown at the surface through varying shades of brownish red to a distinctly yellowish colour in the deeper sub-soils.

(The pH values were determined in the Zomba laboratory, all other determinations being made at the Imperial Institute.)

No.	Lower depth inches	pH	Exchange pH	Percentage of stone and gravel	Percentage of sand in "Fine earth"
1185	1.5	6.14	5.60		
1186	3	6.13	5.62	1.3	43.2
1187	6	6.38	5.58	0.6	44.8
1188	9	6.22	5.38	0.5	43.4
1189	12	6.07	5.13	0.7	42.9
1190	15	5.78	4.98	0.5	47.3
1191	27	5.45	4.64	1.1	50.2
1192	39	5.48	4.69	0.9	53.5
1193	51	5.54	4.74	0.8	46.9
1194	63	5.56	4.73	1.5	55.7
1195	75	5.78	5.49	0.6	57.0
1196	87	6.27	5.57	1.1	54.5
1197	99	6.04	5.72	2.0	49.9
1198	111	6.06	5.57	4.5	48.2
1199	123	6.02	5.31	2.2	49.0
1200	135	6.21	5.52	1.9	41.6
Parent rock powdered		6.27	5.46		

NOTE. The samples were collected by Mr. F. Barker, Agricultural Officer of North Nyasa, who states that they were collected from the bank of the Kowe stream some 500 feet above the Mission estate on the lower slopes of the Nyika. The flora consisted of *Parinari* sp., *Diospyros* sp. *Terminalia sericea*. There was a copious growth of grass, bracken and *Crotolaria* under shrub.

MECHANICAL ANALYSIS OF No. 1185.

A loam soil, reddish brown in colour.

Stones and gravel over 2 mm. ...	0.8
Fine earth 2.0 mm. and under	99.2

				Per cent of fine earth.	
Coarse sand	...	...	2.0 —0.2	...	27.3
Fine sand	...	...	0.2 —0.02	...	14.4
Silt	...	...	0.02—0.002	...	23.3
Clay	...	...	0.002 and under	...	31.3
Moisture at	...	...	105°C	...	2.41
Matter soluble in water	...	...	...	...	0.04
Loss on ignition	...	...	...	...	12.78
Calcium carbonate	...	...	...	...	nil

CHEMICAL ANALYSIS.

Exchangeable bases in soils (Hissink method).

				Per cent of fine earth.		
				Nos. { 1185 1186 1187		
				No. 1191		
				No. 1197		
Lime	...	CaO	...	0.123	...	0.087
Magnesia	...	MgO	...	0.050	...	0.026
Potash	...	K ₂ O	...	0.034	...	0.013
Soda	...	Na ₂ O	...	0.004	...	0.001

Composition of clay fraction.

				(1185			
				Nos. (1186			
				per cent			
				No. 1191			
				per cent			
				No. 1198			
				per cent			
Silica	...	SiO ₂	...	34.12	...	35.79	36.36
Alumina	...	Al ₂ O ₃	...	28.89	...	30.42	30.03
Ferric oxide	...	Fe ₂ O ₃	...	13.27	...	13.51	14.41
Titanium dioxide	...	TiO ₂	...	0.89	...	1.02	0.87
Loss	...	...	...	21.98	...	17.63	16.60
Molecular ratio	...	SiO ₂ Al ₂ O ₃	...	2.00	...	2.00	2.03

Remarks. All the soils in this series contain a good deal of sand, which increases in depth and then decreases again slightly.

Among the exchangeable bases, the amount of lime exceeds in each case that of the magnesia, the percentages of both these constituents appearing to decrease steadily with depth. The quantities of exchangeable potash and soda are low throughout and do not show any regular decrease.

The clay fractions, in spite of marked differences in the colour of the soils, do not vary much in composition, the ratio of silica to alumina being almost exactly 2 in each case.

(Editor's note. The ratio of silica to alumina in the clay fraction of these soils is almost identical with the ratio found in the clay fraction of other soil samples carefully taken in regions with similar climatic conditions.)

REPORT ON CHIMVUA VLEI SOIL SERIES, FOUND IN BROAD VALLEYS AND DAMBOS IN LILONGWE, KASUNGU AND MZIMBA.

BY THE MINERAL RESOURCES DEPARTMENT, IMPERIAL INSTITUTE.

DESCRIPTION OF SAMPLES.

Chimvua vlel soil series, Nos. 1176 to 1183 inclusive. This was a series of sandy soils, the colour of the top soil being almost black, while that of the subsoils passes through various shades of yellowish grey. The series was also noteworthy for the occurrence of one layer (No. 1180) of a marked gravelly character.

RESULTS OF EXAMINATION.

The same determinations were made as in the previous series.

The exchangeable bases were determined in Nos. 1176, 1179 and 1181.

Analysis of the separated clay fractions were made on Nos. 1176, 1179 and 1181 (the two latter representing the layers just above and just below the level of No. 1180, which was gravelly in character and differed markedly in appearance from the remainder of this series).

Imperial Institute No. 2660/3.

Date 28 June, 1932.

Reference No. 1176, Chimvua vlei soil.

Description: A sandy soil, almost black in colour.

Preliminary mechanical analysis on the entire soil, which was air-dried before examination.

		Size of particles in mm.				Per cent
Stones and gravel	...	Over	2.0	...	...	nil
"Fine earth"	...	2.0 and under	...	...	...	100.0

Mechanical analysis of "Fine earth"

		Size of particles in mm.				Per cent
Coarse sand *	...	2.0	to 0.2	...	...	67.0
Fine sand *	...	0.2	to 0.02	...	...	15.4
Silt *	...	0.02	to 0.002	...	...	4.4
Clay *	...	0.002	and under	...	...	11.2
Moisture at 105°C	...	...	...	...	...	1.32
Matter soluble in water	...	...	...	...	...	0.02
Calcium carbonate	...	...	...	...	...	nil
Loss on ignition. Not including moisture at 105°C or CO ₂ from carbonates.	...	...	...	...	...	5.10
		Total				99.34

Dried at 105°C

"Stones and gravel" (particles over 2 mm, diameter)

No.	Per cent of Original Soil		
1177	...	...	0.8
1178	...	...	0.1
1179	...	...	0.2
1180	...	...	16.7
1181	...	...	trace
1182	...	...	0.1
1183	...	...	nil

CHEMICAL ANALYSIS

Exchangeable Bases. (Hissink method).

				Per cent of "fine earth"			
		No. 1177	No. 1179			No. 1181	
Lime	CaO	0.038	0.183	...	...	0.332	
Magnesia	MgO	0.031	0.190	...	...	0.331	
Potash	K ₂ O	0.003	0.020	...	...	0.016	
Soda	Na ₂ O	0.028	0.012	...	...	0.014	

Composition of Clay Fraction.

		No. 1176	No. 1179	No. 1181
Silica	SiO ₂	44.35	41.90	44.84
Alumina	Al ₂ O ₃	27.60	26.72	26.54
Ferric oxide	Fe ₂ O ₃	6.19	12.21	11.07
Titanium dioxide	TiO ₂	2.83	1.76	1.90
Loss	...	17.38	15.67	14.96
Molecular ratio Silica, SiO ₂				
Alumina, Al ₂ O ₃		2.72	2.66	2.87

Percentage of Sand in "Fine Earth"

No.			
1177	...	...	88.6
1178	...	...	48.3
1179	...	...	44.4
1180	...	...	46.6
1181	...	...	37.6
1182	...	...	79.9
1183	...	...	58.4

REMARKS

In this series of soils, the amounts of sand are extremely variable, being remarkably high in Nos. 1176, 1177 and 1182. No. 1180 also contains a considerable proportion of gravel, which imparts a distinctive appearance to this sample.

The percentages of exchangeable lime and magnesia are in each case very closely similar to each other, and while the amounts of these constituents are low in No. 1176, they increase very much in Nos. 1179 and 1181. This increase is probably related to the decreased acidity of these latter samples.

With regard to the composition of the clay fractions, these give similar ratios of silica to alumina, but it is noteworthy that the percentage of ferric oxide is much lower in No. 1176 than in the other two samples.

This series of soils on the whole would probably tend to be very readily permeable to water, and hence to be likely to suffer from drought during a prolonged dry period.

ANALYSIS OF TYPICAL SOILS

	Rukuru silt loam		Vua alluvium		Likuni red loam (in southern Mzimba highlands)		
Moisture ...	...	4.05	...	1.8	...	1.7	1.7
Loss on ignition ...	...	15.45	...	5.1	...	7.8	10.5
Total nitrogen ...	...	.13	...	.102	...	.145	.15
pH ...	...	...	...	7.1	...	6.8	6.2
Potash total by fusion method	.44	}					
Soda " " " "	.05						
Phosphoric oxide " "	.43						
Lime total by fusion method	.93						
Magnesia " " "	.96						
Lime sol. acid ...	...	...	...	...	...	...	.23
Potash soluble in acid ...	.31	...	.336	...	.07	...	.11
Phosphoric oxide " ...	n.d.	...	.142	...	.075	...	.081
" Available " potash ...	.045	...	.015	...	.011	...	.029
" Available " phosphoric acid.	.075	...	.06	...	.005	...	.009
Mechanical analysis							
gravel ...	.30						
coarse sand ...	10.1						
fine ...	34.4						
silt ...	38.7						
clay ...	6.9						

NOTE ON MINOR ELEMENTS OF PLANT FOOD.

It may be noted in the few analyses of typical soils that there are indications of deficiencies of such soil constituents as lime, magnesia or phosphates. Unfortunately soil analyses at the present time cannot give information about deficiencies of minor elements for the growth of plants in new areas.

Troubles due to deficiency in minor elements of plant food have occurred in plant tissues and animals in southern Nyasaland. There is no reason to suppose that northern Nyasaland is in this respect of its soil constituents any different to parts of southern Nyasaland and other parts of Africa. When more exotics are grown with the object of promoting economic progress, likely deficiency of any one of the following elements, zinc, copper, manganese, cobalt, iron, and sulphur, will have to be carefully looked for and the growth of such crops as citrus, tea, tung oil and even introduced food crops may be markedly benefited by applications of certain salts. Similarly the deficiency of certain of these elements in the herbage and introduced fodder plants may be the cause of digestive troubles, a general unthriftiness or even disease of live stock.

LIST OF GRASSES FOUND OVER WIDE AREAS IN NORTHERN NYASALAND.

The native names and localities where often found with remarks on palatability are also given.

The writer is indebted to the Director, Royal Botanic Gardens, Kew for numerous determinations and to the emuneration of Southern Rhodesia grasses by Stent and Ratray, the order of which is followed below:—

GRASSES.

General (G) cinyanja (N)	citumbuka (T) cingoni (A)	ciyao (Y) Common English name (R)
Specific Names	English and Native Names	Locality and Notes
<i>Vossia cuspidata</i>	Hippo grass, msali (T)	Aquatic perennial. Sud of rivers. Good feed when young
<i>Urelytrum squarrosus</i>	tsipi	
<i>Hemarthria fasciculata</i>	Swamp couch (R) msonte	good pasture
<i>Manisuris granularis</i>	kalanbizi	common annual weed
<i>Elyonurus argenteus</i>	Sour grass (R)	common, not liked by stock
<i>Imperata cylindrica</i>	Cotton grass, silver spike (R) kasochi (N)	weed, not eaten
<i>Sorghum</i> ...		
<i>verticilliflorum</i>	mpetapeta (G)	dimba soils N. Nyasa, fair fodder
<i>Sorghum</i> sp. <i>arundinaceum</i> ...	goke (N)	fair fodder
<i>Sorghum purpureo-sericeum</i> ...		orchard country
<i>Sorghum versicolor</i> ...	Black Sudan grass (R) nangombo (N)	
<i>Cleistachne sorghoides</i>	fotafota (G)	
<i>Diectomis fastigiata</i> ...	kachiswaswa (T)	common in Vipya, eaten by stock
<i>Andropogon</i> sp. ...	mpelela, zimpiyi	tall annual
<i>schirensis</i>	sakalambi	sand veld perennials
<i>amplectens</i>		common, Vipya high grass
<i>gayanus</i>		savannah and sandy soils
<i>Cymbopogon Afronardus</i>	msanu, luhu (Y)	
<i>excavatus</i>	Turpentine grass (R) kanumau (T) msewe (N)	not eaten
<i>Hyparrhenia</i> sp. ...	Thatching grasses	high grass savanna
<i>rufa</i> ...	Giant thatching grass sekera (N) cipeta katiti	flood plain and near dambo, fair grazing when young
<i>nyassae</i> ...	kampbi, gogolo	sandy soils, highlands
<i>hirta</i> ...	lipi (Y)	
<i>dissoluta</i> ...		rare
<i>Ruprechtii</i>	yellow thatching grass, kampiti, sowi	common and predominant on good lowland soils
<i>filipendula</i>	fine thatching grass, kanyeche, nyumbu (N)	
<i>Hyparrhenia cymbaria</i>		Vipya and open woodland
<i>gazensis</i> ...	luvundu	
<i>Monocymbium ceresiforme</i> ...	Spear grass (R) nyuni (A)	<i>Themeda</i> grasslands
<i>Heteropogon contortus</i>		common, good fodder when young
<i>Themeda triandra</i> ...	Red grass (R) suchi (Y)	common, Vipya good grazing
<i>Digitaria</i> spp. ...	Finger grasses	
<i>milanjiana</i> ...	luba wa masale (N)	medium pasturage, eaten by stock
<i>Perrottetii</i> ...	senga senga (T)	common, eaten by stock
<i>melanchila</i> ...	kanukura (T)	Kasitu poor soils, eaten by stock
<i>velutina</i> ...	luba (N) tenteri (T)	Kasitu sands, eaten by stock
<i>horizontalis</i> ...	luba wang'ono (N)	meadow grass in Kasitu, eaten by stock
<i>ternata</i> ...		rare
<i>setivalva</i> ...		
<i>Chloridion Cameronii</i>	Gilston grass (R) katsichi (N)	common
<i>Eriochloa Macclounii</i> ...	nkwanje wang'ono (N)	common
<i>Alloteropsis semialata</i>	cigonampiri (N)	
<i>Brachiaria brizantha</i> ...	Upright false paspalum kamokamo (T) nsanje (N)	high grass savanna on good soils
		common in Kasitu better valleys, good pasture and hay
<i>Brachiaria regularis</i>		alluvial sandy loam
<i>deflexa</i> ...		
<i>Paspalum scrobiculatum</i>	kansanji (N)	common on good land, fair fodder
<i>Urochloa pululans</i> ...	Herring bone grass (R) cinsomba (N)	good pasture

GRASSES—continued.

General (G)	...	citumbuka (T)	...	ciyao (Y)	...
cinyanja (N)	...	cingoni (A)	...	Common English name (R)	...
Specific Names		English and Native Names		Locality and Notes	
<i>Echinochloa crus-galli</i>		patupatu (T)	...	common, eaten by stock	
„ <i>colona</i>	...	Shama millet (R), jungle rice, mphunga	...	common in dambos, good fodder	
„ <i>pyramidalis</i>		Antelope grass (R)	...	good hay	
„ <i>haploclada</i>				dambo	
„ <i>stagnina</i>				dambo	
„ <i>frumentacea</i>		Barnyard millet (R)			
		cindumba (N)	...	cultivated	
<i>Oplismenus Burmannii</i>		kalelekani	...		
<i>Bothriochloa insculpta</i>		kasarasora (T) chivu (N)		Kasitu better soils, eaten by stock	
<i>Panicum spp.</i>		sukumulani (T)	...	eaten by stock	
„ <i>maximum</i>	...	{ Guinea grass (R)			
		{ kwatamujani (A)	...	excellent fodder	
		{ kwanje wantengo			
„ <i>phragmitoides</i>				coarse	
„ <i>deustum</i>		chiputu	...		
„ <i>gracilicaule</i>	...	kapungapunga (T)	...		
„ <i>miliaceum</i>		proso millet, kwanji		cultivated	
<i>Setaria phramitoides</i>		Reed timothy		flood plain clays	
„ <i>palustris</i>				dambo and orchard country Kasitu valley.	
„ <i>glauc</i>		mbadwi			
„ <i>verticillata</i>		cinamu (T)		common, old gardens weed, good fodder.	
„ <i>grandis</i>				Nyika plateau: suspected poison.	
„ <i>detica</i>		kotikoti (G)		cultivated	
		Fox tail millet			
„ <i>sphacelata (aurea)</i>		Golden Timothy		good red soils. Good fodder.	
		grass,			
		nchiru ya garu			
		wangono (N)			
		mdyapwiti (N)			
<i>Tricholaena Monachne</i>			...	alluvium	
<i>Rhynchelytrum nyassanum</i>		idyapwiti (N)			
„ <i>roseum</i>	...	Natal red top grass	...	common, old land	
		cagalamu (T) utululu			
„ <i>minutiflorum</i>					
<i>Melinis minutiflora</i>		Molasses grass (R)			
		kunkulire	...	good fodder	
„ <i>ambigua</i>	...				
„ <i>longicauda</i>	...		...	Vipya	
„ <i>macrochaeta</i>	...				
<i>Pennisetum purpureum</i>		Napier fodder (R)			
		sanjiri (G)	...	good soils. Excellent fodder	
<i>Pennisetum clandestinum</i>		Kikuyu grass			
„ <i>unisetum</i>	...		...	high grass savannah	
„ <i>glaucocladum</i>			...	dambo	
„ <i>ciliare</i>	...				
<i>Beckeropsis uniseta</i>		nchira ya garu (N)			
<i>Oryza sativa</i>					
„ <i>Bartii</i>	...	Wild rice, chiri	...	common in N. Nyasa alluvial flats	
<i>Leersia hexandra</i>	...		...	common in marshland	
<i>Trichopteryx simplex</i>	...	Russet grass.	...	Mzimba higher lands	
		mpudzakubelu			
<i>Tristachya leucothrix</i>		oats grass, uzimba			
<i>Tristachya inamoena</i>		oat like grass,	...	Vipya and Mzimba hillsides, eaten by stock.	
		Kachimbare (T)			
<i>Koeleria cristata</i>	...		...	sandy soils, good fodder	
<i>Phragmites vulgaris</i>	...	Bango 'reed grass'	...	used for baskets, thatching, cosmopoliton	
<i>Agrostis sp.</i>	...	sakadzinga (N)			
<i>Aristida submucronata</i>		Wire grasses, nchira			
		yankhandwe			
<i>Perotis indica</i>	...				
<i>Tragus racemosus</i>	...	Carrot seed grass,			
		mnyamza	...	common	
„ <i>Berteronianus</i>	...		...	rare	
<i>Sporobolus spp.</i>	...	Drop seed grasses			
„ <i>fimbriatus</i>	...		...	alluvium	} no importance
„ <i>festuvs</i>	...		...	Kasitu better soils.	
„ <i>strictus</i>	...		...	Vipya	} for forage.
<i>Sporobolus pyramidalis</i>		mtsindi (N)		common	
<i>Pogonarthria squarrosa</i>		malarupoki (A)			
		tantanyerere			
		mulanpanye	...	common, dambo, not eaten	

GRASSES—continued.

General (G)	...	citumbuka (T)	...	ciyao (Y)	...
cinyanja (N)	...	cingoni (A)	...	Common English name (R)	
Specific Name		English and Native Name		Locality and Notes	
<i>Eragrostis</i> sp.	...	Love grasses, nsinde (G) tsichi		common on sandy loams near dambos.	
.. <i>biflora</i>	...	pokopoko			
.. <i>Chapelieri</i>	...	katsiki, nakapereri			
.. <i>brizoides</i>	...	nakapereri			
.. <i>aspera</i>	...	languluka (A)	...	eaten by stock	
		mwalale (N)			
.. <i>pilosa</i>	...	nzala (Y)			
.. <i>ciliaris</i>	...	njalale			
.. <i>namaquensis</i>	...	namauta			
.. <i>major</i>	...	mulampanji, zondo (A)		Kasitu sandy loams. Eaten by stock.	
.. <i>tenella</i>	...	mudyampeta (N)	...	old garden sites. Eaten by stock.	
.. <i>teniufolia</i>	...	kasongo (T)			
<i>Mariscus hemisphaericus</i>			...	high grass savannah	
<i>Diplachne fusca</i>	...				
.. <i>biflora</i>	...	senderanko (T)	...	Kasitu valley. Fair pasture and hillsides.	
<i>Microchloa abyssinica</i>		mukocha (A)	...	Kasitu poor soils. Fair pasture.	
.. sp.	...				
<i>Cynodon dactylon</i>	...	Doob or Couch grass (R) lawn grass,		Fair pasture	
		ntamburuka (T)			
		kapinga (N)			
<i>Chloris pycnothrix</i>					
.. <i>virgata</i> var. <i>elegans</i>			...	common, good hay, pasture.	
		namichira Old			
		Lands grass. (N) thura-			
		thura (T)			
.. <i>gayana</i>	...	Hunyani or Rhodes			
		grass (R) mayolera (N)			
<i>Eleusine indica</i>	...	toramakora (T)	...	good pasture	" " " "
				fields.	
		Ox grass			
<i>Eleusine coracana</i>	...	finger millet (R)	malesi	gardens, eaten by stock.	
		(T), lipoko (A)	usanje		
		(Y) mawere (N)	...	several varieties.	
.. <i>vertivillata</i>	...	phukusa (T) ?	...	alluvium, eaten by stock.	
<i>Dactyloctenium aegyptium</i>	...	Crowsfoot grass (R)...		common. Good hay on sandy soils. Seeds	
		mbelele (N)	msiza-	may be eaten in times of famine.	
		mpiri (A)			
<i>Leptocarydion</i>					
.. <i>Vulpiastrum</i>		Sugar grass (R)	...	Luwazi valley. Frequent dambo and orchard	
		kakonokono (T)		country at 2,000'	
		nakazimbe (N)			
<i>Leptochloa caerulea</i>					
<i>Schmidtia pappophoroides</i>			...	alluvium, flood plains	

RUSHES

<i>Cyperus papyrus</i>	...	Papyrus
<i>Typha angustifolia</i>	...	Bulrush, manjeze (N)

ASPECTS OF THE CATTLE INDUSTRY IN NORTH NYASA.

BY F. BARKER, C.D.A. (EDIN.) AND A. J. W. HORNBY, M.B.E.

Concentration of cattle: The total area of the district of North Nyasa is now estimated at 3,486 square miles in which there are nearly 30,000 head of cattle. It is attempted in the attached table to indicate the distribution of population and cattle in the areas under the various native authorities. The acreage suitable for agriculture and pasturage of varying degree in value is taken as a fraction of the whole areas. If the cultivated acreage necessary for food requirements be taken as a minimum of three acres to each adult male there remains the acreage which is estimated as available for each head of stock. Gardens under bush fallow are included as pasturage and not in the cultivated area. As will be seen this acreage varies from 18 to 126 but if the most densely populated areas under Kyungu with most cattle are considered it is found that the balance of land left for live stock amounts to 10 acres for each head of cattle. It is considered that this is nearly saturation point in these areas. There are only scanty and indifferent grazing areas available for most of the dry season.

Increase in cattle: Although there are no markets for cattle or their products and the cattle are small and of poor quality there is a definite tendency for herds to increase. The reduction of herds which once obtained by raiding or warfare no longer persists. The reasons for this increase are briefly that cattle are not viewed as a source of food except for certain milk products (vern Lukama), and that cattle are regarded as wealth and often as currency. The bride price is invariably paid in cattle and often there is no great differentiation between a good beast and a poor beast in bartering or trading.

Between 1926 and 1932 there was an increase of six per cent and this rate of increase owing to absence of any serious incidence of disease is fully maintained. Regular dipping since 1932 assists in reducing tick borne diseases and noxious parasites to a minimum.

Indeed the increase in cattle may be regarded as becoming a serious problem. Little assistance in the alleviation of this problem can be looked for from native owners for similar reasons given above for the comparatively rapid increase.

Poor quality of the stock: Over-stocking and in-breeding are leading to the general prevalence of a very poor type of animal which moreover can be regarded as less immune to the cattle diseases present in northern Nyasaland than the prototypes. It may be noted that the Veterinary Department have done valuable work in castration of surplus and inferior males.

Suggested methods of amelioration: It will be noted that the Wankonde tribes under Kyungu, etc., are the largest cattle owners and that they care well for their stock in such aspects as good housing in their own long huts and the stock are generally well watered and pastured the life-long day instead of so much resting on bare ground seen elsewhere. Such owners then may lend themselves better to methods of amelioration of the conditions likely soon to prevail.

Such methods then must include

(a) reclamation of old grazings by re-planting of superior grasses such as woolly finger grass and fodder bushes and even trees.

(b) persuasion of owners in hand feeding with such materials as groundnut residues or hay and ultimately use of bedding and manufacture of a compost such as Indore which will lead to improved fertility and decreased number of parasites.

(c) fostering improvement in the breed rather than increasing the numbers.

Potential markets for cattle products: A greater consumption of either dried or fresh meat by the owners or by tribes in other districts is very desirable. The substitution of money in the bride price may eventually come about with advantage.

Greater sales of other products such as hides, suet, etc., would follow greater consumption of meat.

The production of ghee has distinct possibilities but here we would sound a note of warning. Under the conditions likely to prevail in the early stages of the industry there will be a wastage of the solids-not-fat such as casein, sugar and the mineral portion of the milk. These are of great value in feeding children and young stock and it must be deprecated if, in establishing such an industry, numerous children will go short of these materials and may live continually on the threshold of deficiency diseases as indeed some of them already do. Also if production is carefully managed the wastage may be avoided by feeding skim milk to pigs or making certain cheeses. Indeed when all the aspects of the cattle industry in North Nyasa are considered it is necessary to put any change which the stock owners will regard as revolutionary on a sound economic basis and to proceed very slowly with an establishment of a market or factory for meat and dairy products.

NOTE: Many fodder crops do well in northern Nyasaland. At lower elevation, pigeon pea, sugar cane, edible canna and in drier areas spineless cactus. Root crops including yams, eddoes and tania are a useful standby in times of scarcity and are easily grown everywhere. At higher elevations the stock owner who contemplates extra feeding and improved pasturage should utilize woolly finger grass, guinea grass and Napier fodder, Kikuyu grass, and reed timothy for hay and increased plantings. These grasses together with *Echinochloa* and *Sorghum* spp. do well at lower elevations.

Native Authority		Area suitable for pasturage and agriculture in acreage		Population (approximate number of all males)		Head of cattle		Minimum acreage for food requirements		Acreage avail- able per head of stock carried
Nyondo	...	145,920	...	3,228	...	5,891	...	9,684	...	25
Mweni-misuku	...	110,080	...	3,674	...	4,084	...	11,022	...	24
Kiripula	...	91,520	...	3,877	...	4,467	...	11,631	...	18
Kyungu	...	128,640	...	4,526	...	8,801	...	13,578	...	13
Mweni-wenya	...	194,560	...	1,259	...	1,515	...	3,777	...	126
Ntalile	...	222,400	...	1,046	...	1,825	...	3,138	...	120
Mwafuilwa	...	222,400	...	4,231	...	2,952	...	12,693	...	69

